Robin Industrial Engines®

SERVICE MANUAL

Model
EY45V

1193S108

ROBIN AMERICA, INC.
ROBIN TO WISCONSIN ROBIN
ENGINE MODEL CROSS REFERENCE LIST

ROBIN	WISCONSIN ROBIN
SIDE VALVE	
EY08	W1-080
EY15	W1-145
EY15V	W1-145V
EY20	W1-185
EY20V	W1-185V
EY23	W1-230
EY28	W1-280
EY35	W1-340
EY40	W1-390
EY45V	W1-450V
EY21	EY21W
EY44	EY44W
EY18-3	EY18-3W
EY25	EY25W
EY27	EY27W
OVERHEAD VALVE	
EH11	WO1-115
EH12	WO1-120
EH15	WO1-150
EH17	WO1-170
EH21	WO1-210
EH25	WO1-250
EH30	WO1-300
EH30V	WO1-300V
EH34	WO1-340
EH34V	WO1-340V
EH43V	WO1-430V
TWO CYCLE	
EC13V	WT1-125V
DIESEL	
DY23	WRD1-230
DY27	WRD1-270
DY30	WRD1-300
DY35	WRD1-350
DY41	WRD1-410

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1. SPECIFICATIONS

Model		EY45V
Type		Air-Cooled, 4-Cycle, Vertical Shaft, Single Cylinder Gasoline Engine
Bore x Stroke		90 mm x 70 mm (3.54" x 2.75")
Piston Displacement		445 cc (27.15 cu. in)
Maximum Horse Power		12HP/3600 r.p.m. (SAE Code-J607a)
Maximum Torque		2.5 kg-m/2600 r.p.m. (18.08 ft-lbs./2600 r.p.m.)
Direction of Rotation		Counter-clockwise as viewed from P.T.O. shaft side
Cooling System		Forced Air Cooling
Lubrication		Oil Pump
Lubricant		Automobile Oil SAE #20 ~ 30, Class SC
Carburetor		Horizontal Draft, Float Type
Fuel		Automobile Gasoline
Fuel Feed		Gravity Type
Governor		Centrifugal Flyweight Type
Ignition System		Flywheel Magneto Type (Solid State Ignition)
Spark Plug		NGK BPM6A
Charging (Lighting) Capacity		DC 12V-1.5A Battery Charge AC12V-15W or 100W Lighting Coil (Optional)
Starting System		Electric Starter (Recoil Starter: Optional)
Dry Weight		Approx. 35 kg (77.1 lbs.)
Dimensions	Length	415.5 mm (16.35")
	Width	373.5 mm (14.7")
	Height	312 mm (12.28") excluding P.T.O. Shaft

2. PERFORMANCE

2-1 MAXIMUM OUTPUT

The maximum output of an engine is such a standard power as produced by the engine with its throttle valve fully opened after its initial break-in period when all the moving parts are properly worn in. Therefore, a new engine may not produce the maximum output in the beginning because the moving parts are not in a properly worn-in condition.

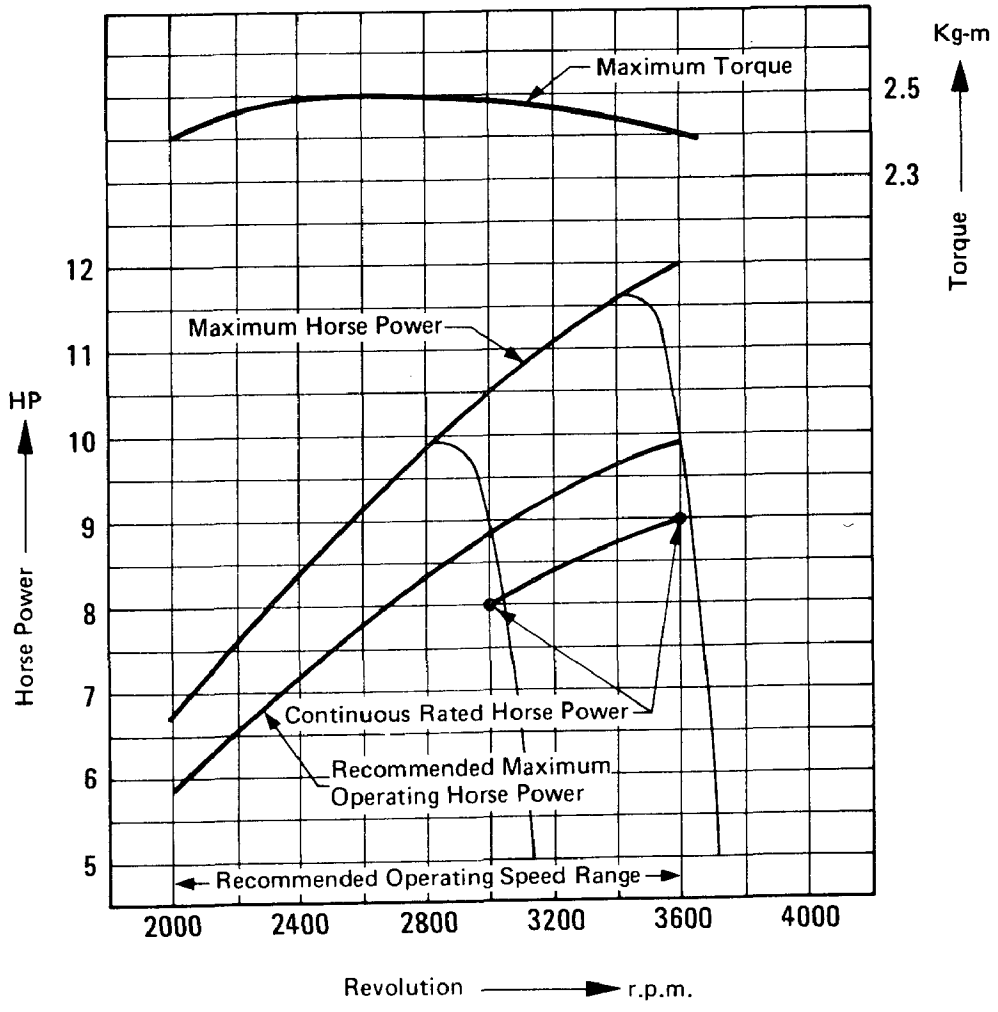
2-2 CONTINUOUS RATED OUTPUT

The continuous rated output of an engine is such a power as produced by the engine when running continuously at an optimum speed, and most favorable from the viewpoint of engine life and fuel consumption ratio, with the governor in operation. It is suggested, therefore, that when designing a driving system for any mechanism, with this engine as prime mover, the continous power requirement of that mechanism be kept below the continuous rated output specified.

2-3 MAXIMUM TORQUE AT MAXIMUM OUTPUT

These mean the maximum torque of the output shaft at the maximum output of an engine.

PERFORMANCE CURVES



3. FEATURES

1. The cylinder and crankcase is a light weight one-piece aluminum diecasting. The dimensions are as small as those of a 10-horsepower engine.
2. The engine is powerful with a wide torque range from low speed to high.
3. The vibration-free design with twin balancer shafts.
4. A pointless electronic ignition system is adopted as standard, which makes the ignition system maintenance-free. You will no longer be troubled by worn contact points or faulty sparking from wrong ignition timing.
5. The engine employs a special cast iron cylinder liner, a forged steel crankshaft, main ball bearings at both sides and forced spray lubrication by oil pump for prolonged durability. All this adds up to improved durability.

4. GENERAL DESCRIPTION of ENGINE CONSTRUCTION

4-1 CYLINDER, CRANKCASE

The cylinder and crankcase is single piece aluminum diecasting. The cylinder liner, made of special cast iron, is molded into the aluminum casting. The intake and exhaust ports are located on one side of the cylinder.
The crankcase has a fitting surface on the output shaft side, where the main bearing cover is attached. (See Fig. 1.)

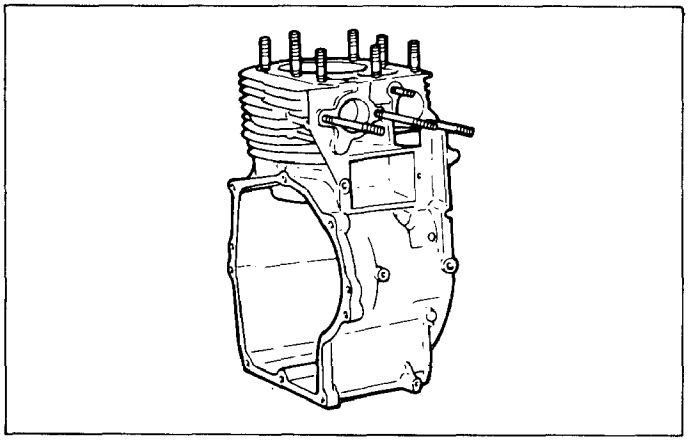


Fig. 1

4-2 MAIN BEARING COVER

The main bearing cover is an aluminum diecasting, which is mounted on the output shaft side of the crankcase. Remove the main bearing cover to expose the inside of the engine for inspection.
The main bearing cover also serves as an oil pan, with a trochoid oil pump, oil filler and oil drain plug. (See Figs. 2 and 3.)

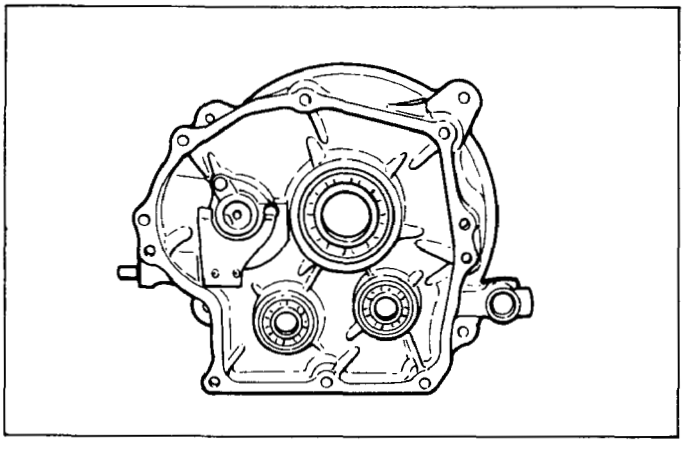


Fig. 2

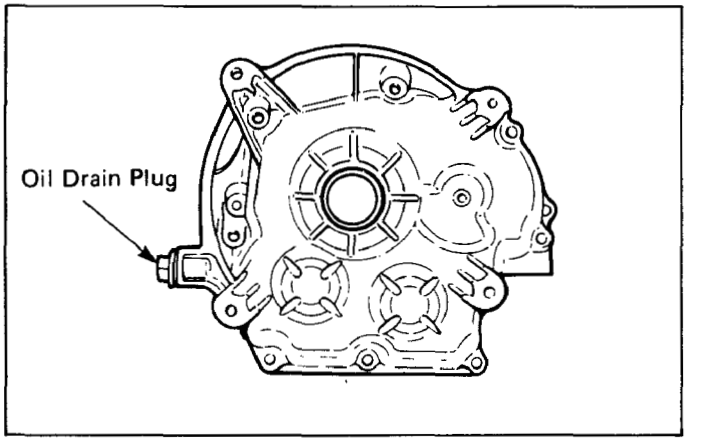


Fig. 3

4-3 CRANKSHAFT

The crankshaft is forged carbon steel, and the crank pin is induction-hardened. The output end of the shaft has a crankshaft gear and balancer gear that are pressed into position. (See Fig. 4.)

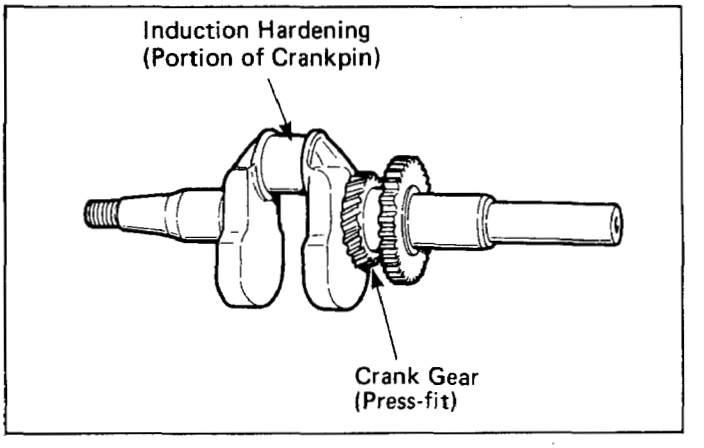


Fig. 4

4-4 CONNECTING ROD and PISTON

The connecting rod is forged aluminum alloy, and its large and small ends serve as bearings. The piston is an aluminum alloy casting, and carries two compression rings and one oil ring. The piston pin hole is offset from the center of the piston to reduce hitting noise and improve durability. (See Fig. 5.)

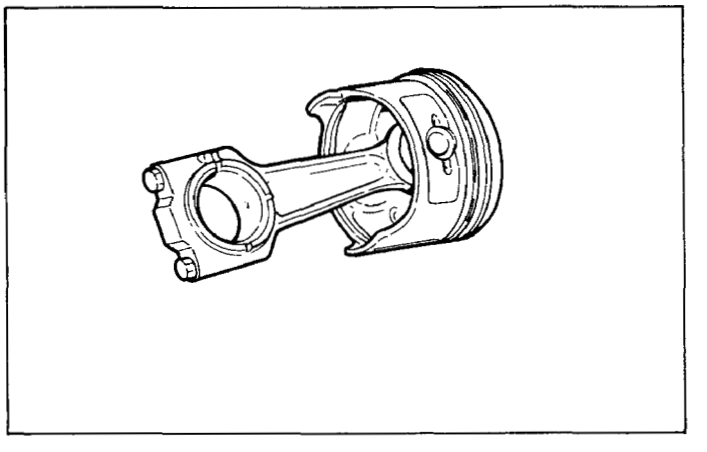


Fig. 5

4-5 CAMSHAFT

The camshaft is a hollow special cast iron integrally molded with the camshaft gear. The governor plate is riveted to it, and one end of the camshaft has a pin for driving the oil pump. (See Fig. 6.)

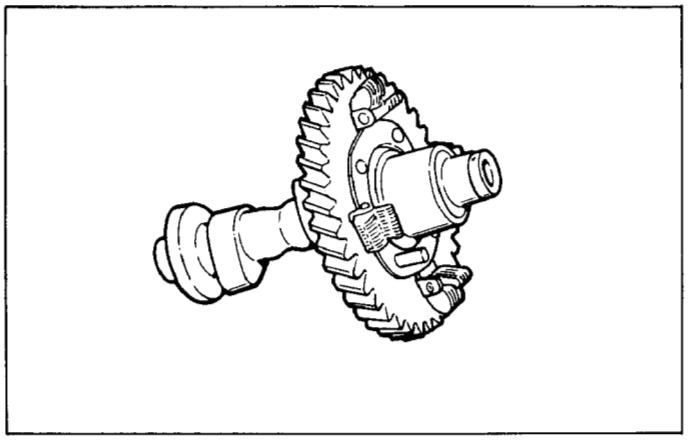


Fig. 6

4-6 VALVE ARRANGEMENT

The intake valve is located at flywheel side of the crankcase.
Hard alloy valve seats are molded in the cylinder block for added durability. (See Fig. 7.)

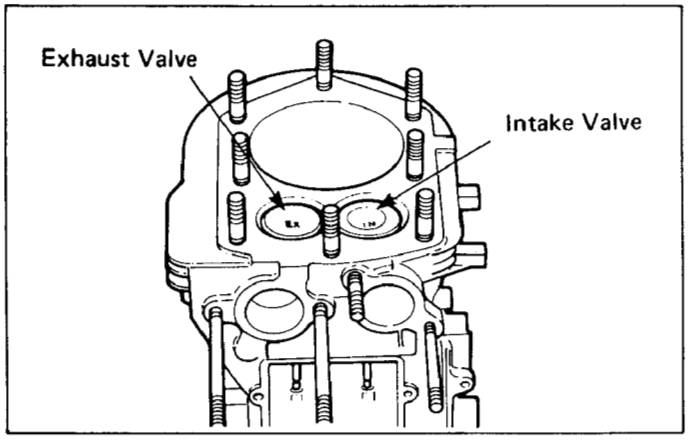


Fig. 7

4-7 CYLINDER HEAD

The cylinder head is an aluminum die casting, and forms a Ricardo type combustion chamber with ample area for high combustion efficiency.
(See Fig. 8.)

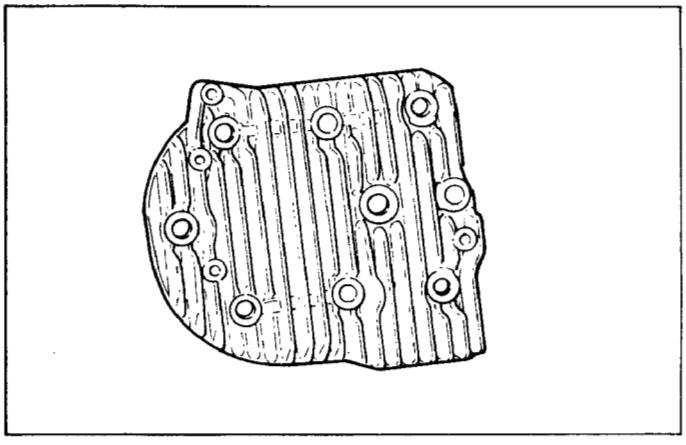


Fig. 8

4-8 GOVERNOR

The governor is a centrifugal flyweight type which permits constant operation at the selected speed against load variations. Governor gear is installed on the bearing cover, and it engages with the cam gear after reassembling. (See Fig. 9.)

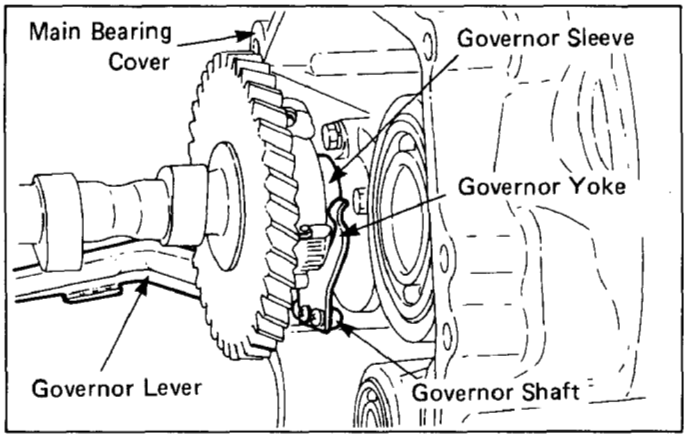


Fig. 9

4-9 COOLING

The cooling fans on the flywheel cool the cylinder and cylinder head by forced air cooling. Cylinder baffles is provided for guiding the cooling air.

4-10 LUBRICATION

The trochoid oil pump is mounted inside of the main bearing cover.
Oil pump is driven by the camshaft to supply oil for the rotating or sliding parts. (See Fig. 10.)

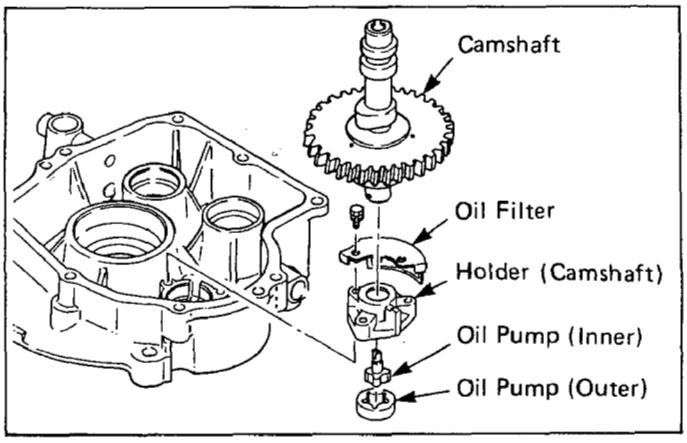


Fig. 10

4-11 IGNITION

The ignition system is a flywheel magneto type with ignition timing set at 23° before TDC. The magneto is composed of a flywheel and ignition coil. The flywheel is mounted directly on the crankshaft, and ignition coil on the crankcase. (See Fig. 11.)
(For further details, refer to page 30, Section **"7. MAGNETO"**.)

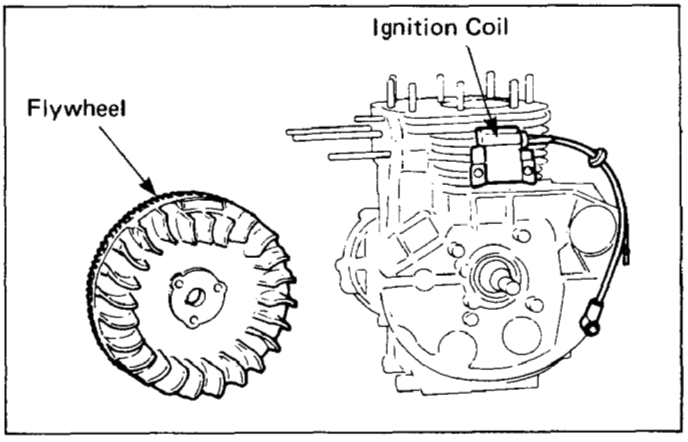


Fig. 11

4-12 CARBURETOR

A horizontal draft carburetor is employed. It has been carefully set after thorough tests to assure satisfactory start up, acceleration, fuel consumption, output performance, etc. (See Fig. 12.)
For construction and other details, refer to page 32 Section **"8. CARBURETOR"**.

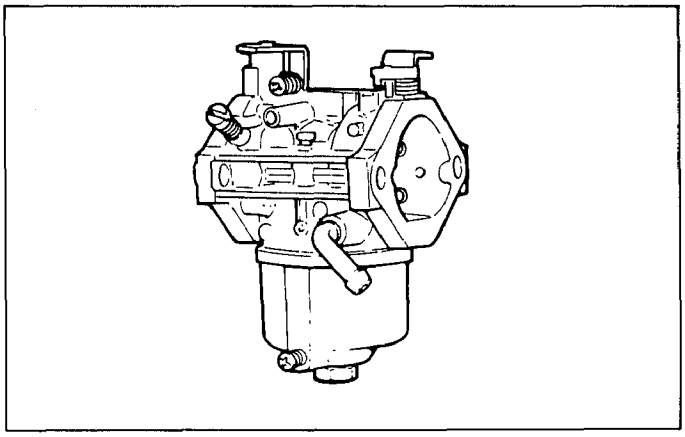


Fig. 12

4-13 AIR CLEANER

The air cleaner is a semicyclone type with double elements. (See Fig. 13.)

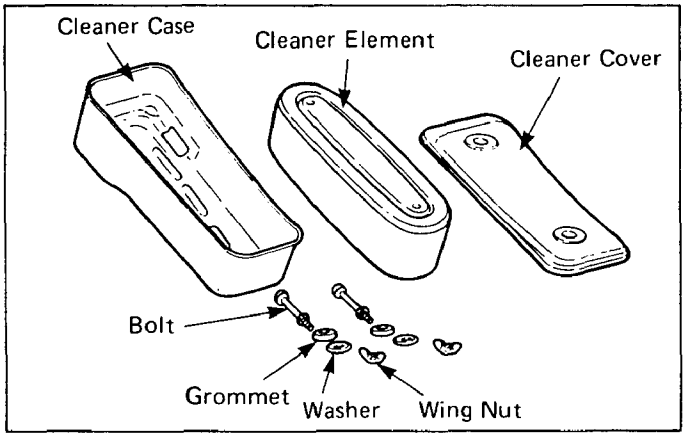


Fig. 13

4-14 BALANCERS

Unbalanced moments of inertia that are generated in the vertical and horizontal directions are balanced by the two balancers that rotate 1 to 1 with the crankshaft to effectively reduce vibration.
(See Fig. 14.)

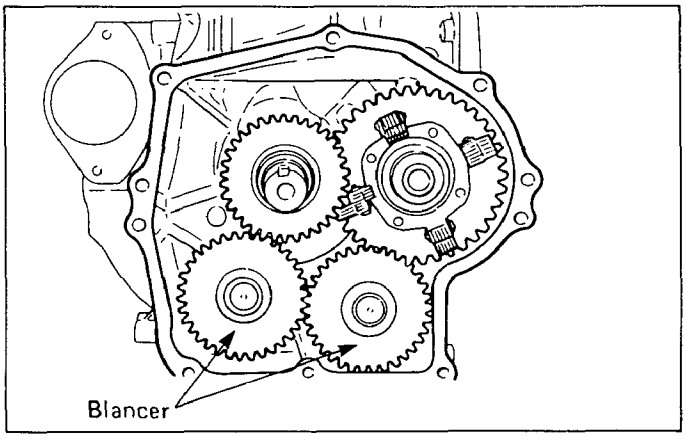
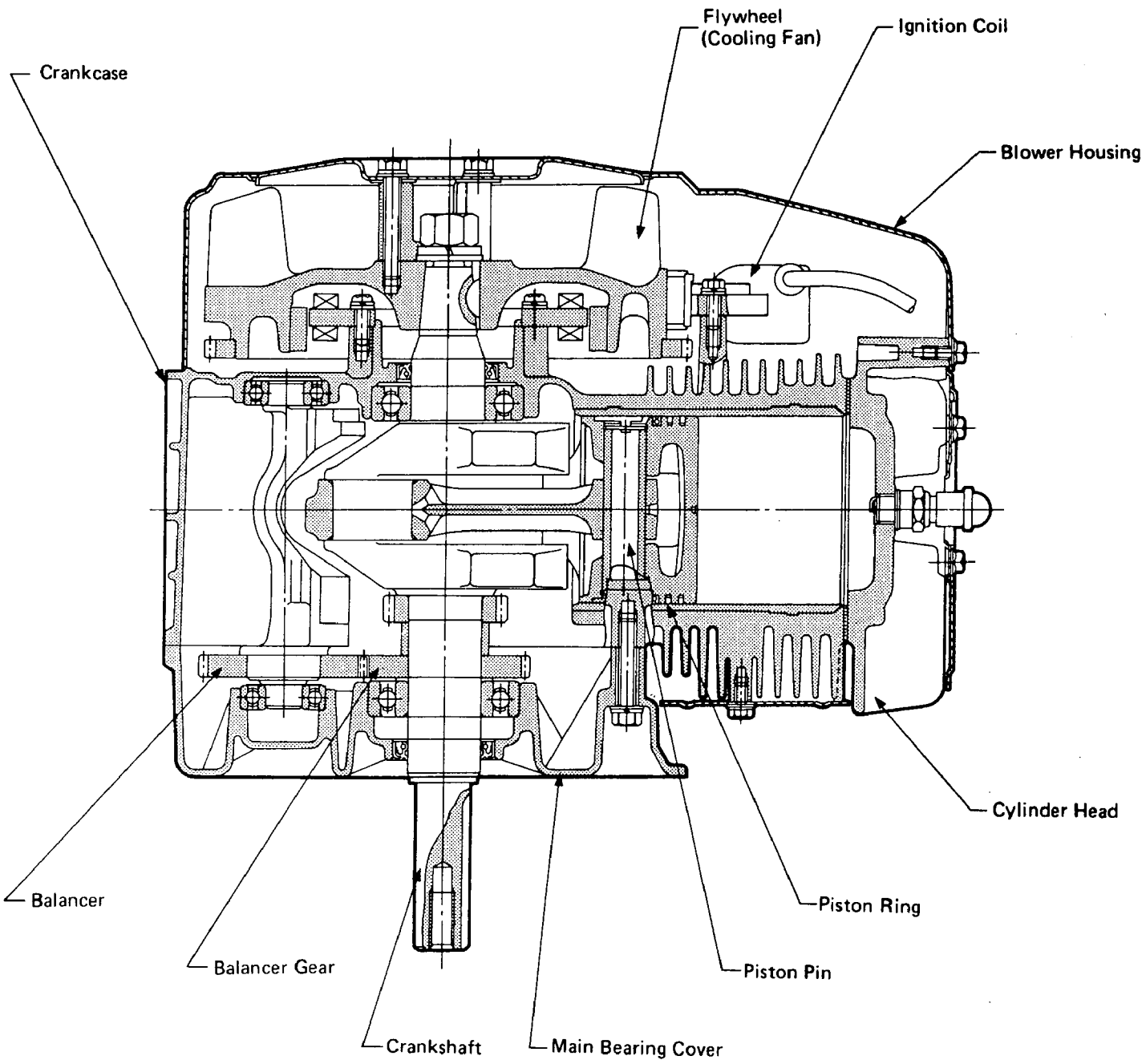
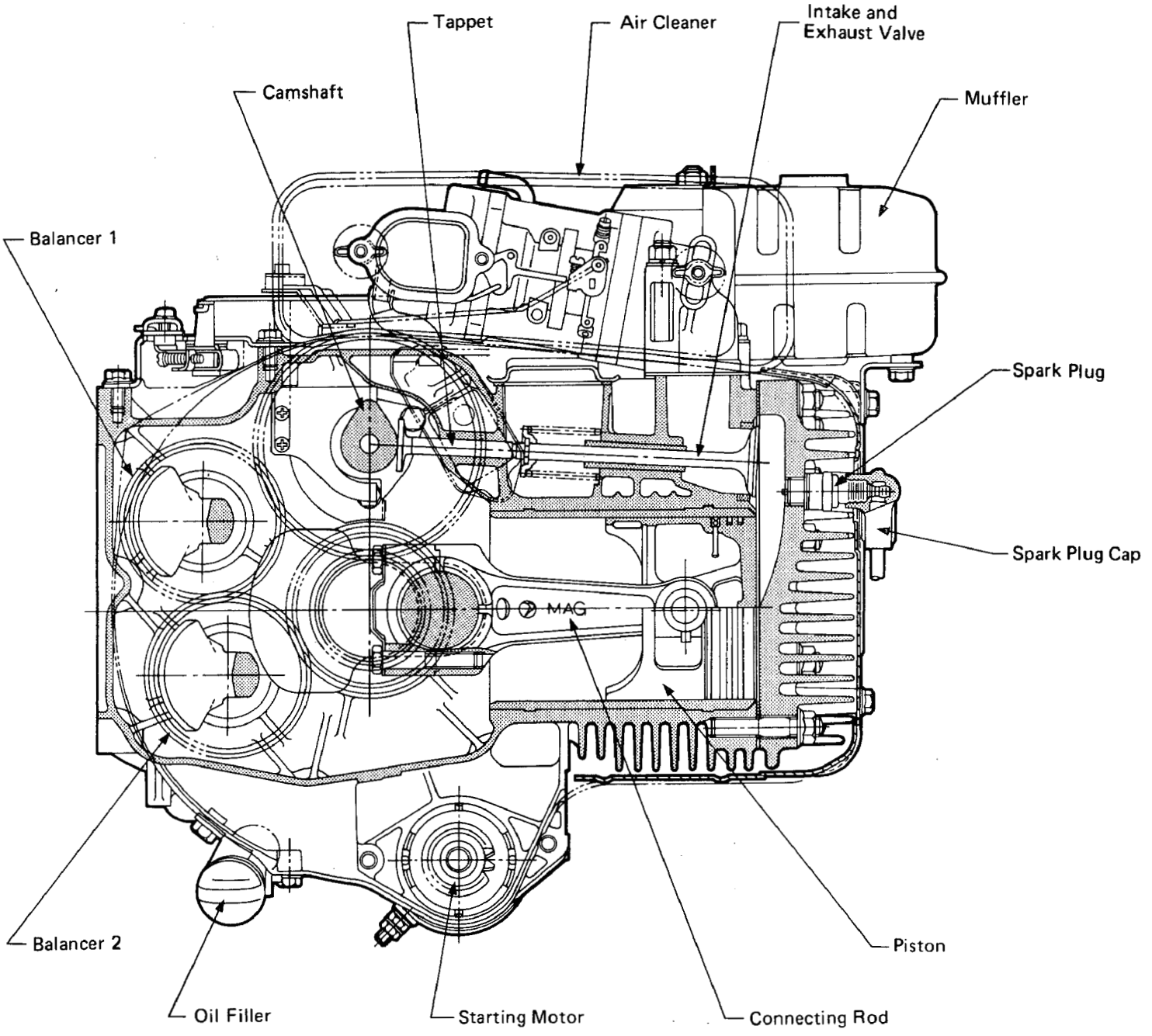


Fig. 14

4-15 SECTIONAL VIEW of ENGINE




Tappet
Air Cleaner
Intake and
Exhaust Valve
Camshaft
Muffler
Balancer 1
Spark Plug
Spark Plug Cap
MAG
Balancer 2
Piston
Oil Filler
Starting Motor
Connecting Rod

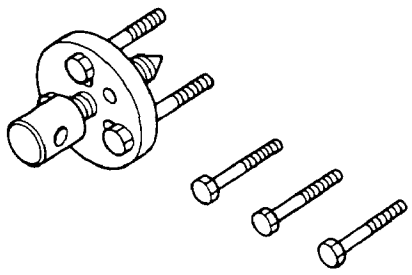
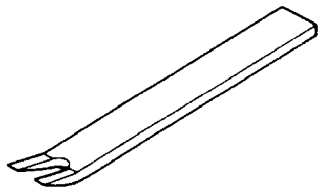
5. DISASSEMBLY and REASSEMBLY

5-1 PREPARATIONS and SUGGESTIONS

1) When disassembling the engine, memorize well the locations of individual parts so that they can be reassembed correctly. If you are uncertain of identifying some parts, it is suggested that tags be attached to them.
2) Have boxes ready to keep disassembed parts by group.
3) To prevent missing and misplacing, temporarily assemble each group of disassembed parts.
4) Carefully handle disassembed parts, and clean them with washing oil.
5) Use the correct tools in the correct way.

5-2 SPECIAL TOOLS

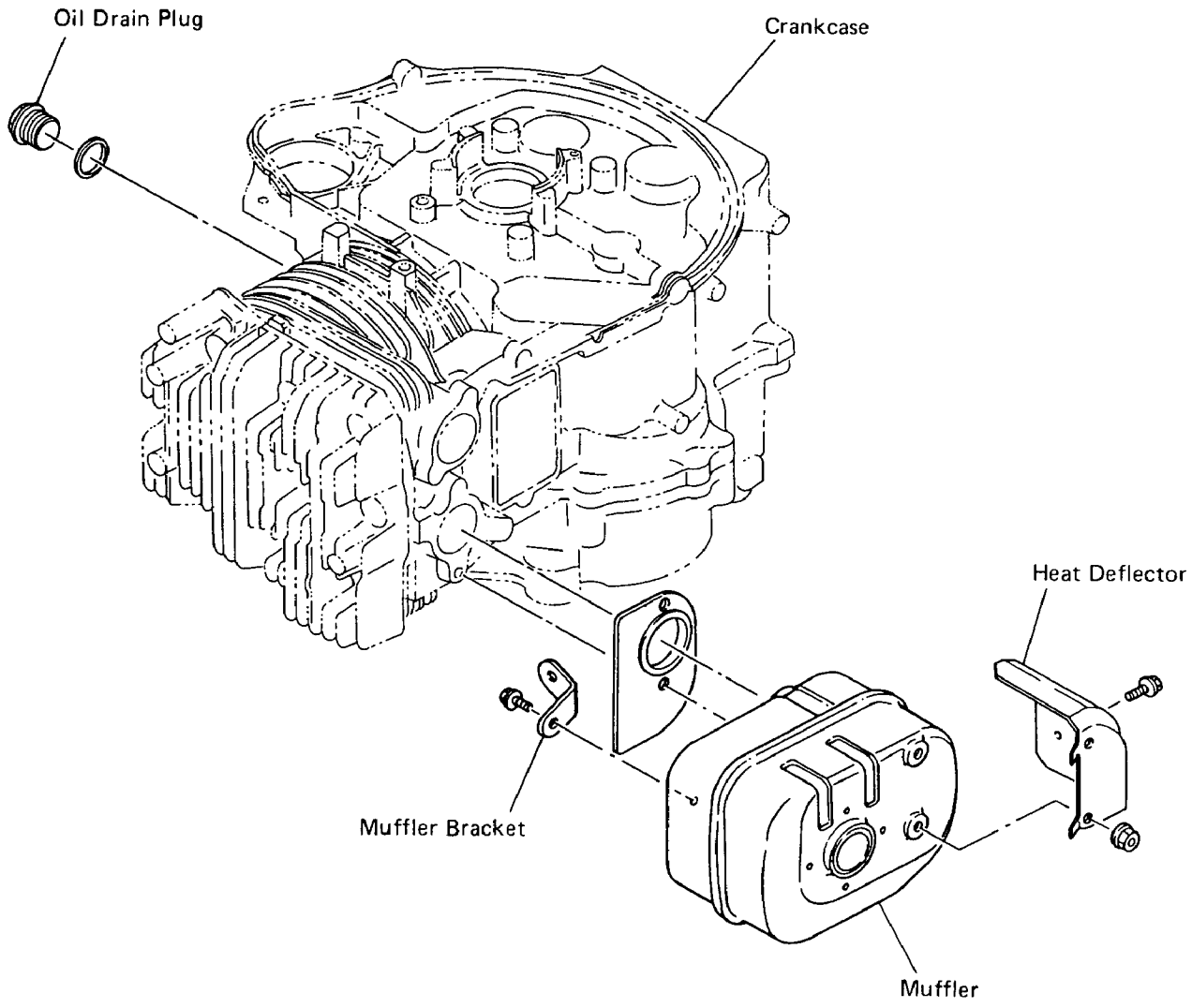
For your reference, the following table shows special tools for disassembling Robin Engines.

Part No.	Tool	Use	Applicalbe Model	Shape
209 95004 07	Flywheel Puller (with bolt)	For pulling off Flywheel	EY10, 13, 14 EY15, 18, 20 EY25, 27, 28 EY33, 35, 40 EY44, 45 EC05, 07, 10 EC17, 25, 37	
207 95003 07	Valve Spring Retainer	For mounting and dismounting Valve Spring Retainer and Retainer Lock	EY10, 13, 14 EY15, 18, 20 EY25, 27, 28 EY33, 35, 40 EY44, 45	

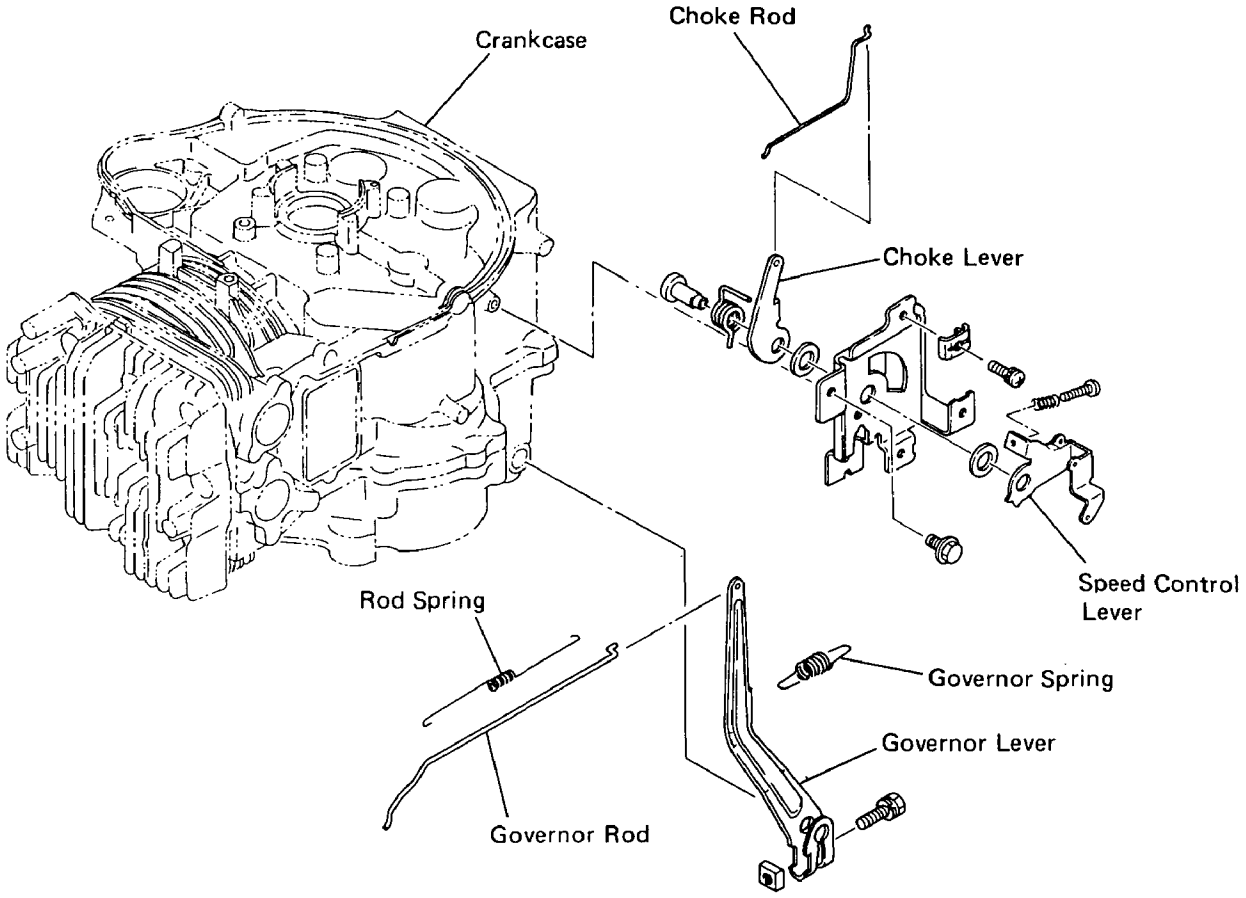
5-3 HOW TO DISASSEMBLE

*Bolt length is the length from bolt end to the bottom surface of bolt head.

Order	Item	Procedure	Remarks	Tool
1	Engine (Oil drain plug)	Remove oil drain plug and discharge oil.	Be careful not to lose gasket.	17 mm box wrench
2	Muffler and bracket	(1) Remove muffler bracket. (2) Turn up heat deflector tabs, and remove nuts.		10 mm box wrench 12 mm box wrench



Order	Item	Procedure	Remarks	Tool
3	Governor lever	(1) Remove governor lever from shaft. (2) Remove governor spring and governor rod from governor lever.	Memorize or mark the governor spring hooking position.	10 mm box wrench
4	Speed control	(1) Remove speed control assembly from crankcase. (2) Remove choke rod from speed control assembly.		10 mm box wrench



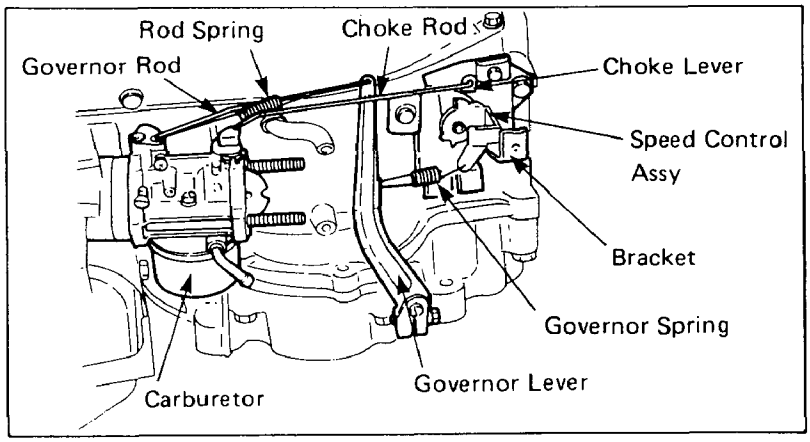
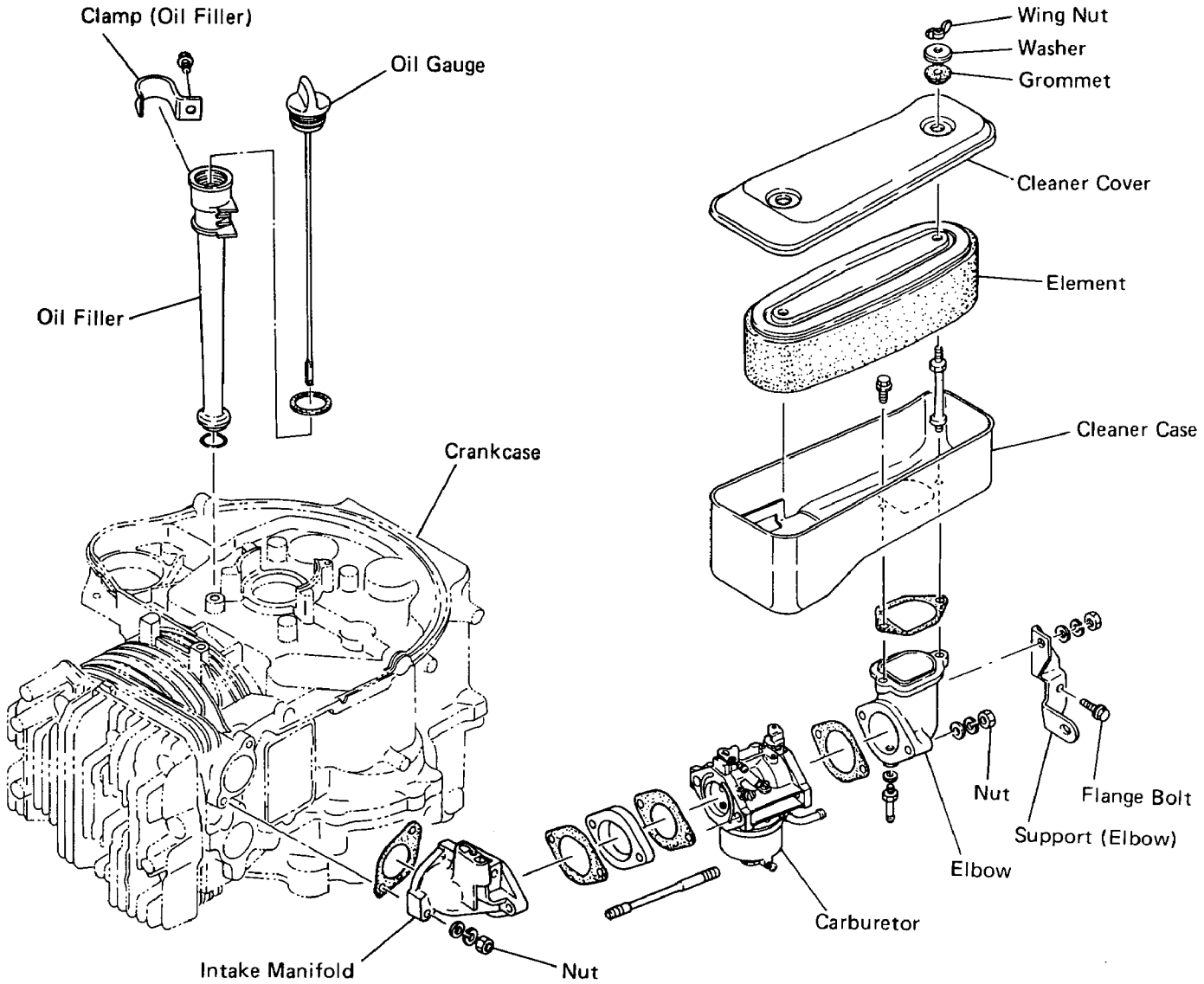
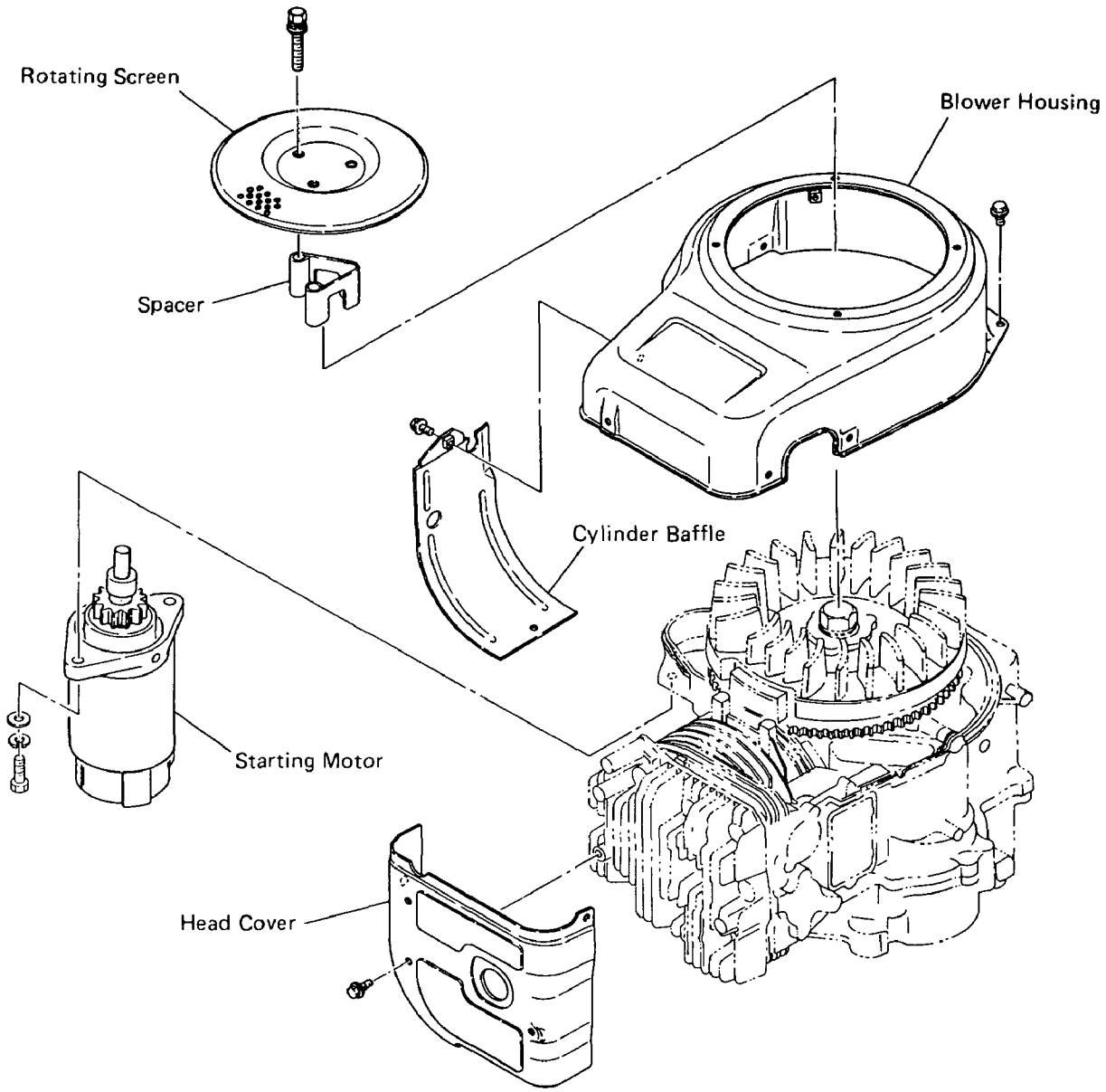


Fig. 15

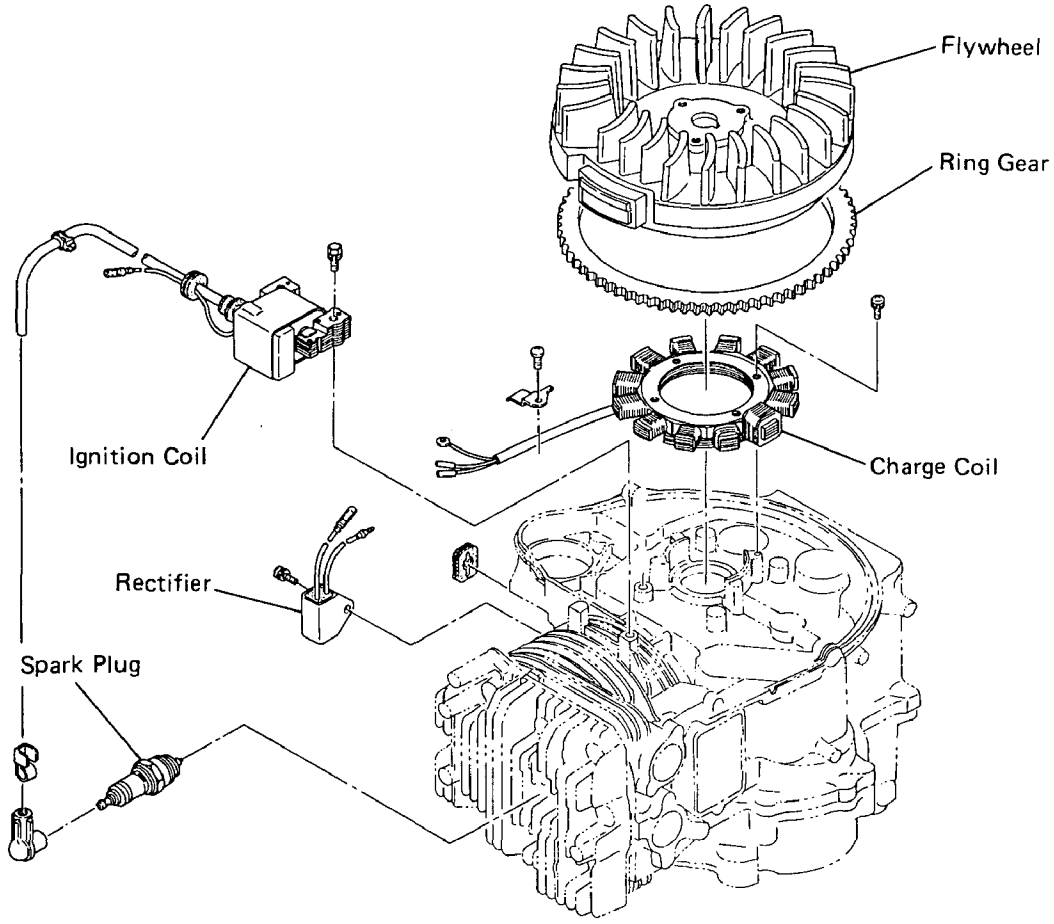
Order	Item	Procedure	Remarks	Tool
5	Air cleaner	(1) Remove wing nuts, cleaner cover, and element. (2) Remove cleaner case.		10 mm wrench
6	Carburetor and intake manifold	(1) Remove support (elbow) bolt on crankcase side. (2) Remove intake manifold nuts, and assembly of intake manifold, carburetor and elbow from engine. (3) Separate carburetor and elbow from intake manifold if necessary.	Disconnect breather pipe at elbow side end.	10 mm box wrench 12 mm box wrench 12 mm box wrench
7	Oil filler	(1) Remove clamp (oil filler). (2) Pull out oil filler from main bearing cover.	Be careful not to lose O-ring.	10 mm box wrench



Order	Item	Procedure	Remarks	Tool
8	Starting motor	Remove starting motor.		12 mm box wrench
9	Rotating screen	Remove rotating screeen and spacer.		12 mm box wrench
10	Blower housing and head cover	(1) Remove blower housing. (2) Remove cylinder baffle. (3) Remove head cover.		10 mm box wrench



Order	Item	Procedure	Remarks	Tool
11	Igntion coil	Remove ignition coil from crankcase.	**Be sure to remove ignition coil first.**	10 mm box wrench
12	Flywheel and lighting coil	(1) Remove nut from tip of crankshaft. (2) Remove flywheel using flywheel puller. (See Fig. 16.) (3) Remove charge coil. (See Fig. 17.)	(Ring gear is located inward of ignition coil, so, if flywheel is pulled out first, case may become broken.)	24 mm box wrench Phillips screwdriver



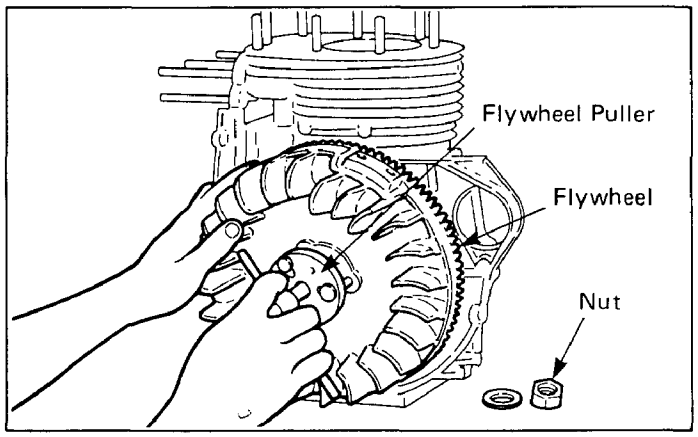


Fig. 16

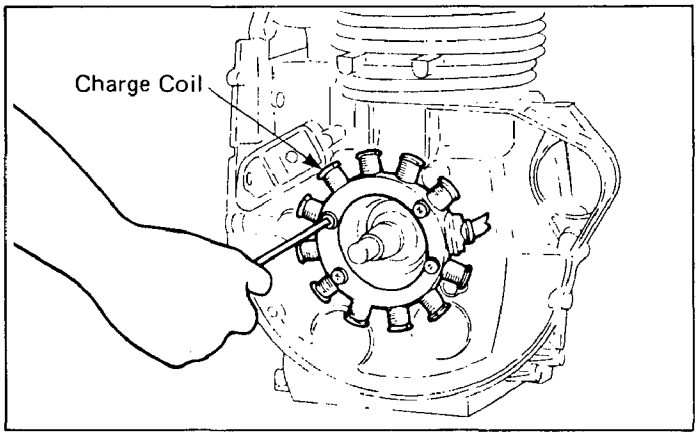


Fig. 17

Order	Item	Procedure	Remarks	Tool
13	Cylinder head	(1) Remove spark plug. (2) Remove cylinder head.		19 mm plug wrench 14 mm box wrench
14	Breather	(1) Remove breather cover. (2) Remove breather plate.	Be careful of gaskets.	10 mm box wrench
15	Intake and exhaust valves	(1) Remove tappet cover. (2) Using a valve spring retainer, remove retainer lock from valve stem. (3) Remove intake and exhaust valves. (See Fig. 18.) (4) Remove spring retainers and valve springs.	Intake and exhaust valves use the same valve spring, retainer, and retainer lock, but in case of reusing them, reassemble them exactly as before.	10 mm box wrench Valve spring retainer
16	Main bearing cover	(1) Remove bolts. (2) Remove main bearing cover by lightly tapping its side with a plastic hammer. (See Fig. 19.)	• Be careful not to damage oil seal with PTO shaft keyway. • Be careful not to lose crankshaft and camshaft adjusting spacers.	12 mm box wrench

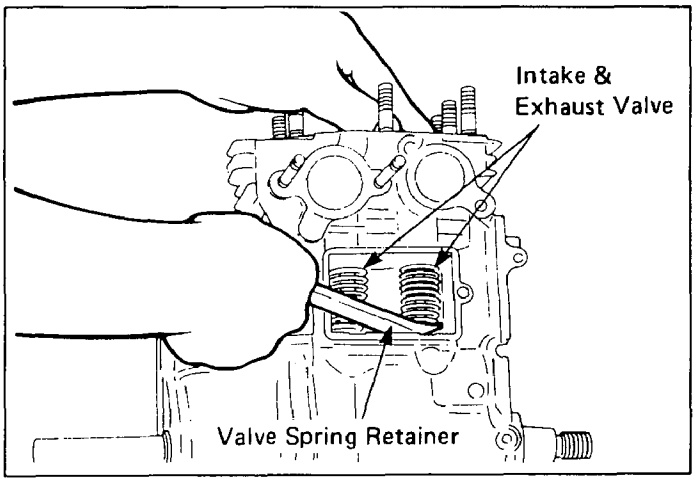


Fig. 18

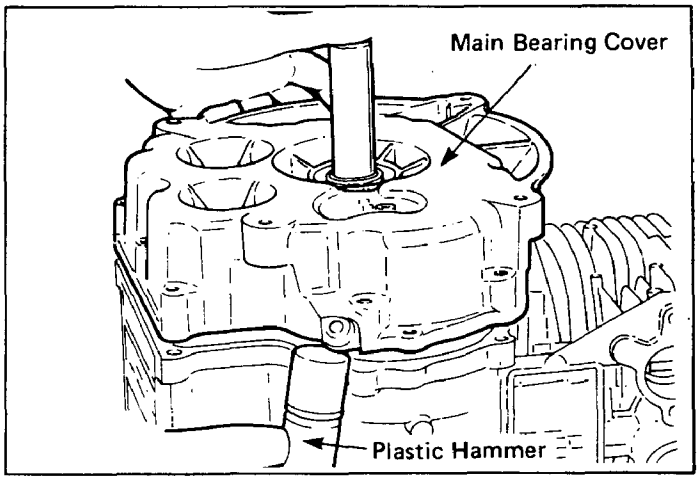
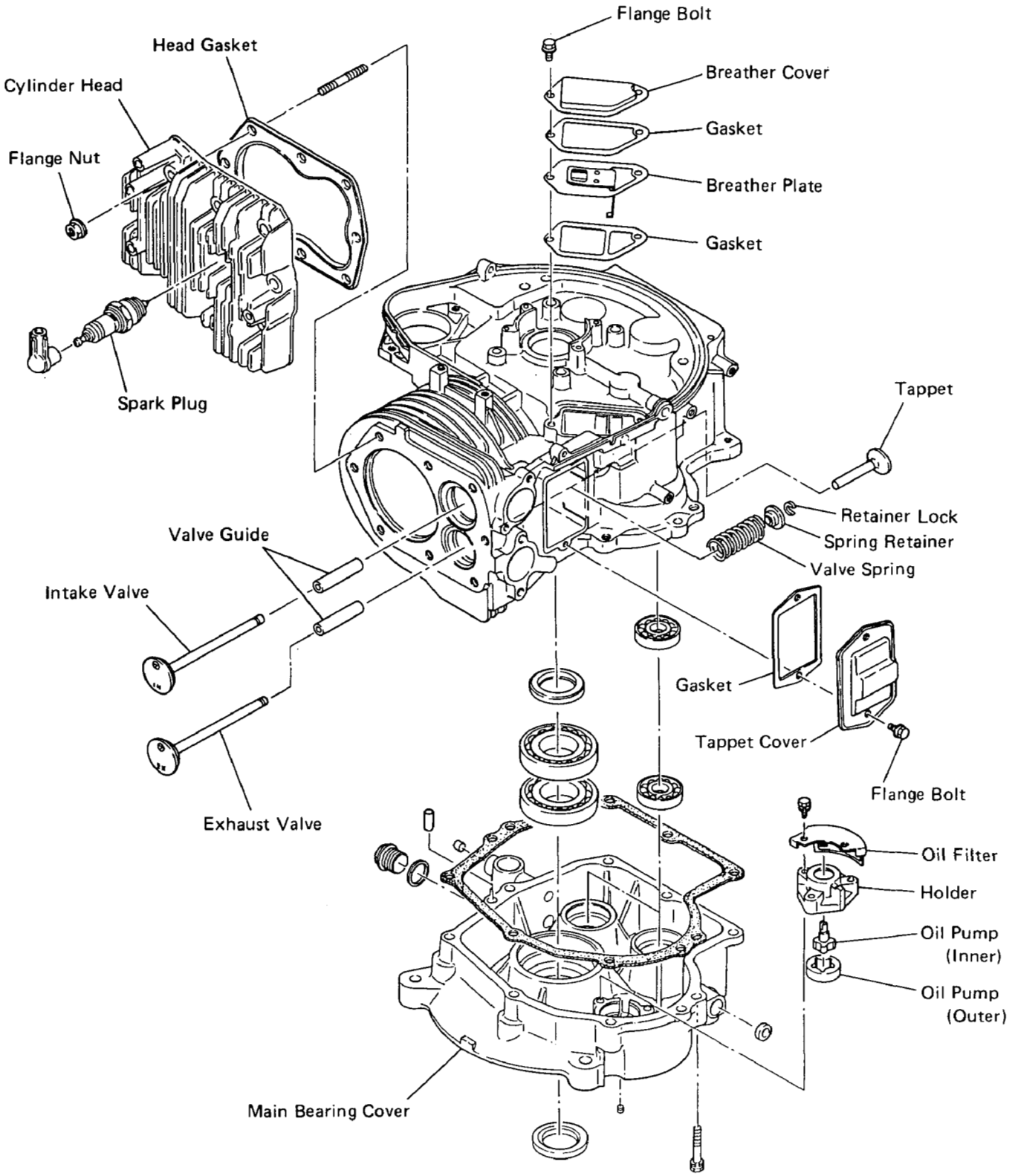
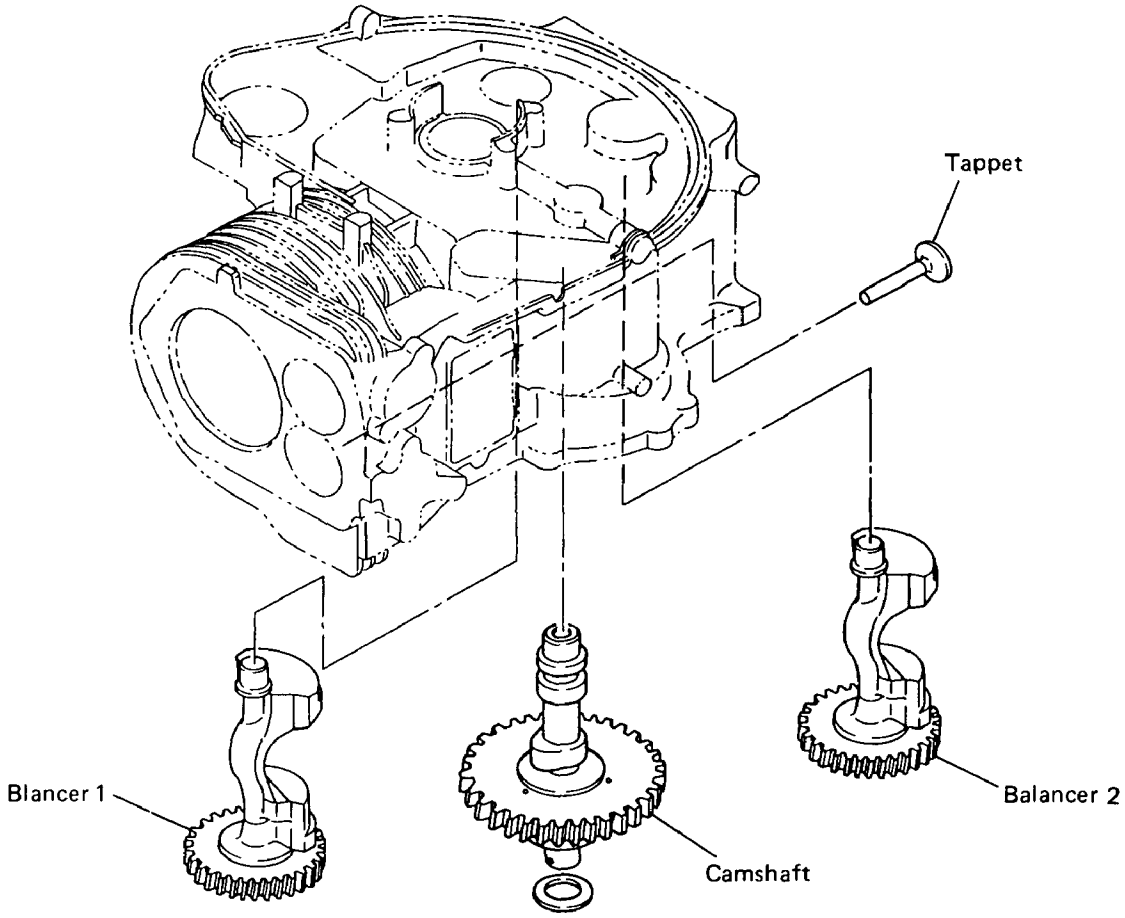


Fig. 19


Flange Bolt
Head Gasket
Breather Cover
Cylinder Head
Gasket
Flange Nut
Breather Plate
Gasket
Spark Plug
Tappet
Retainer Lock
Valve Guide
Spring Retainer
Valve Spring
Intake Valve
Gasket
Tappet Cover
Flange Bolt
Exhaust Valve
Oil Filter
Holder
Oil Pump
(Inner)
Oil Pump
(Outer)
Main Bearing Cover

Order	Item	Procedure	Remarks	Tool
17	Balancers	(1) Turn crankshaft to top dead center. (2) Remove balancers. (See Fig. 20.)		
18	Camshaft and tappets	(1) Remove camshaft. (See Fig. 21.) (2) Remove tappets.	The tappets for intake and exhaust valves are interchangeable, but in case of reusing, reassemble exactly as before.	12 mm box wrench



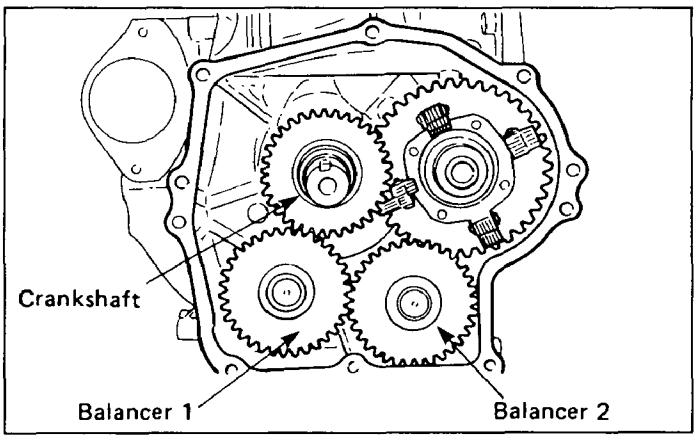


Fig. 20

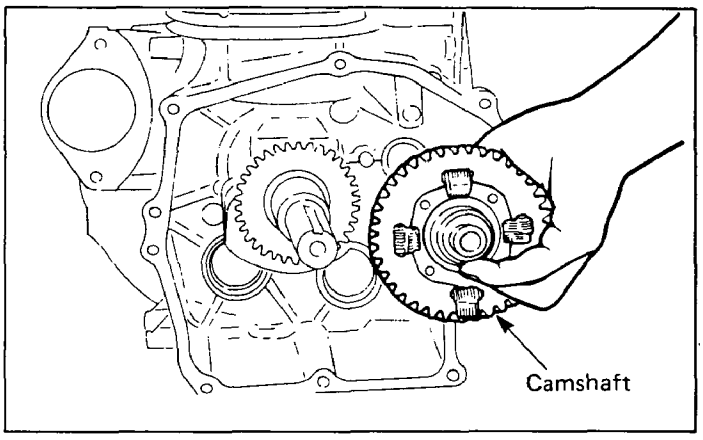
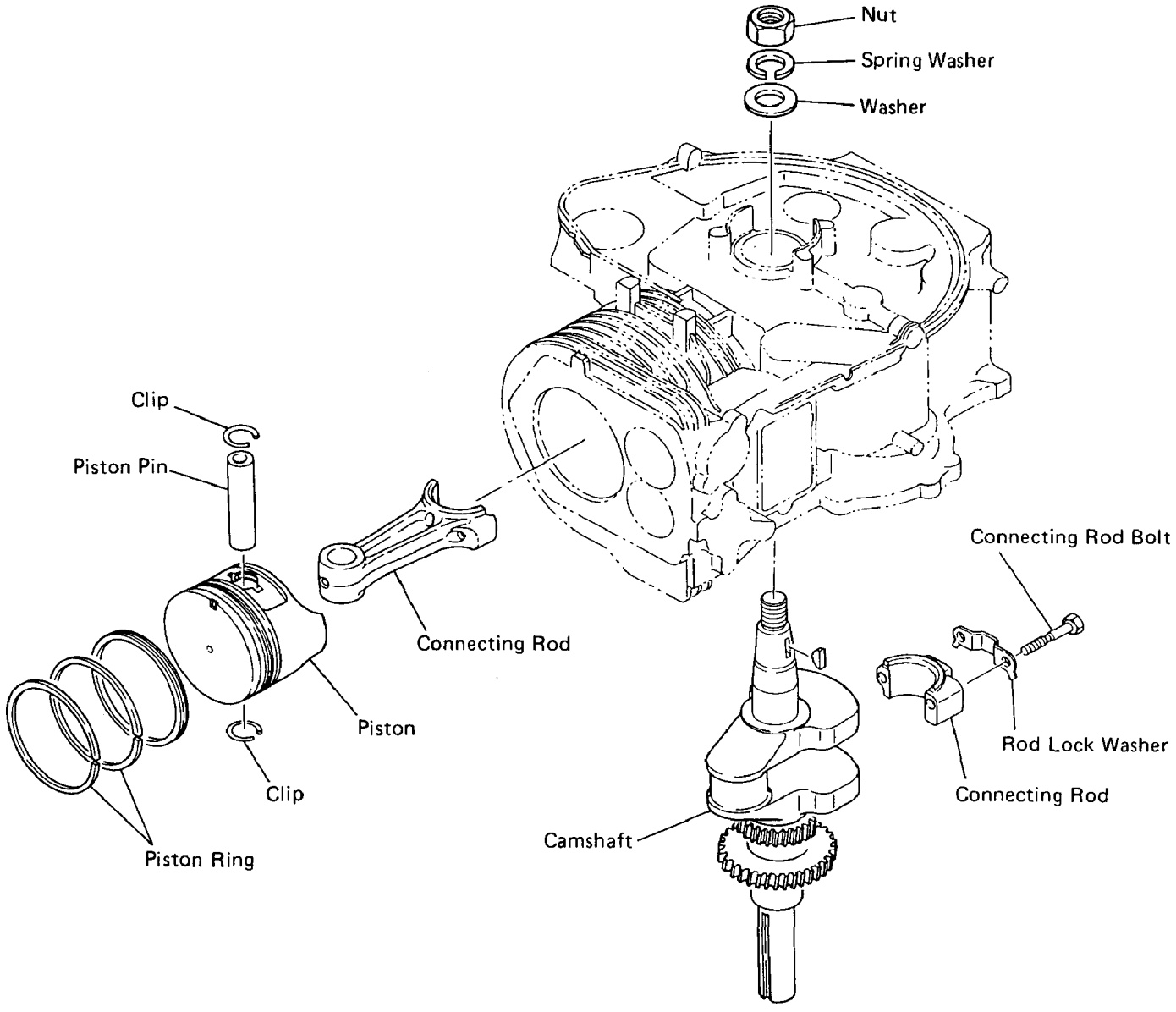


Fig. 21

Order	Item	Procedure	Remarks	Tool
19	Connecting rod	(1) Turn up lock washer tabs and remove bolts. (2) Remove connecting rod large end cap, push piston up out of cylinder.		12 mm box wrench
20	Crankshaft	Remove crankshaft by lightly tapping its fly-wheel end.	Be careful not to damge crankcase oil seal.	



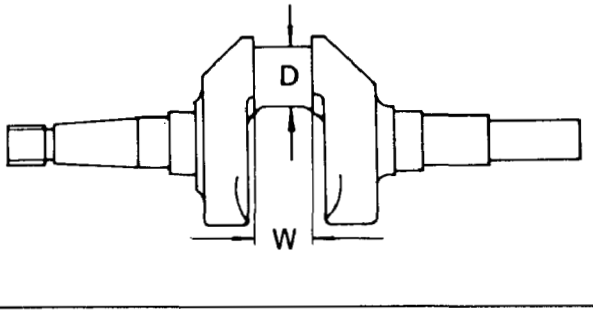
5-4 HOW TO REASSEMBLE

5-4-1 PRECAUTIONS IN REASSEMBLY

1) Every and each part should be cleaned thoroughly. Especially, pay utmost care and attention to the cleanliness of the piston, cylinder, crankshaft, connecting rod and bearings.
2) Scrape off carbons completely from the cylinder head and the piston top; especially the carbon adhered in the groove of the piston ring should be careflly and completely taken out.
3) Carefully check the lip portion of every oil seal. If faulty one is found, replace it without any hesitation. Apply enough oil to the lip portion of the oil seal when reassembling.
4) Replace all the gaskets with new ones.
5) Replace the key, pin, bolt, nuts, etc. with new one, if necessary.
6) Whenever tightening torque is specified, conform to the specified figures.
7) Apply oil to the rotating parts and friction surfaces, when reassembling.
8) Check and adjust the clearances of various portions and then reassemble.
9) When some main portions are assembled in the course of reassembling, turn or move the gadgets by hand and pay attention to the frictional noise and resistance.

5-4-2 MEASURING CRANKCASE and CRANKSHAFT

Bore the cylinder or take other steps as necessary to meet the following specifications before reassembling.



D (Crankshaft Pin Dia.)		38 dia. $^{-0.050}_{-0.066}$ mm
W (Crankshaft Pin Width)		$29\ ^{+0.1}_{0}$ mm
Bore		90 dia. $^{+0.006}_{-0.016}$ mm
Piston Outside Diameter (In Skirt Thrust Direction)		89.973 dia. $^{0}_{-0.02}$ mm
Piston to Cylinder at Piston Skirt Thrust Face		0.011 L ~ 0.053 L
Piston Ring Gap (To Ring ~ Second Ring)		0.1 L ~ 0.3 L
Piston Ring Side Clearance in Grooves	Top	0.11 L ~ 0.15 L
	Second	0.06 L ~ 0.10 L
	Oil	0.01 L ~ 0.05 L
Clearance between Connecting Rod Large End and Crankshaft Pin	Clearance between Inside and Outside Diameter	0.050 ~ 0.082 L
	Side Clearance	0.1 L ~ 0.3 L
Clearance between Connecting Rod Small End and Piston Pin		0.010 L ~ 0.032 L
Clearanc between Piston Pin and Piston Pin Hole		0.011 T ~ 0.011 L

L: LOOSE T: TIGHT

Table 1

5-4-3 ASSEMBLING ORDER and PRECAUTIONS

1) Place the tappets into the crankcase.

NOTE: The intake and exhaust tappets are the same, but mark them differently when disassembling because of different valve clearances; and fit them into their original place. Apply oil to the tappets beforehand.

2) Assemble the crankshaft and camshaft at the same time.

NOTE: The timing marks are punched on the crankshaft gear and the camshaft gear. Match these timing marks when assembling. (See Fig. 22.)

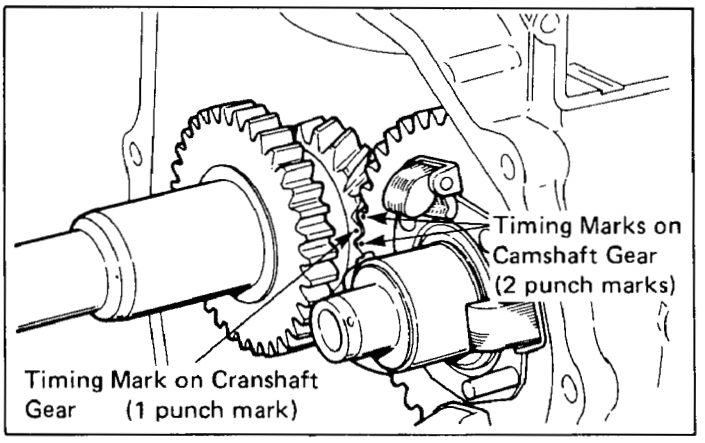


Fig. 22

3) Assemble the connecting rod and the piston.

NOTE: The piston is offset. Assemble it so that the square (□) on the piston top matches the ❼ MAG mark on the connecting rod. (See Fig. 23.)

CAUTION: When inserting the piston pin and fitting the clip on, be careful not to damage the piston surface.

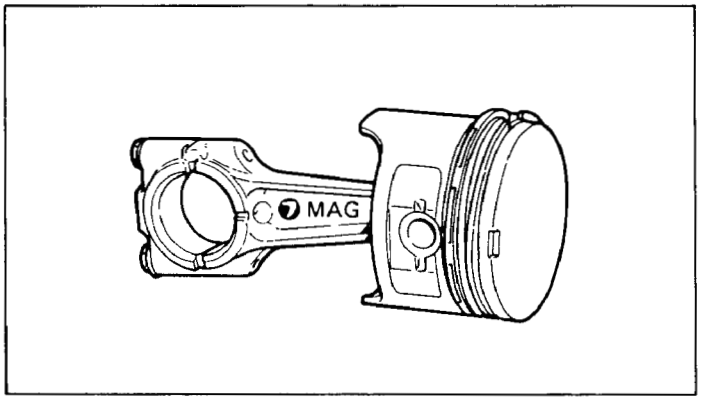


Fig. 23

4) Fit the piston rings on the piston.

NOTE: Each piston ring has a punched mark on its open end. These marks have to face upward when assembled.

NOTE: When the piston rings are fitted in place, make sure that their ends are staggered as shown in Fig. 24. Be careful not to install them in the wrong groove. (See Figs. 24 and 25.)

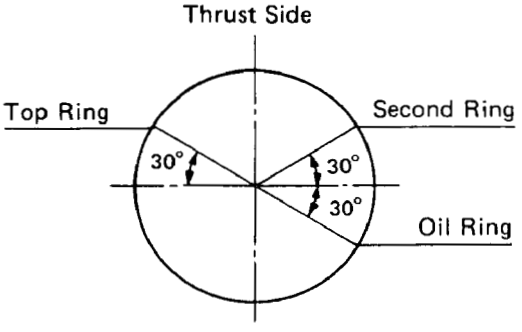


Fig. 24

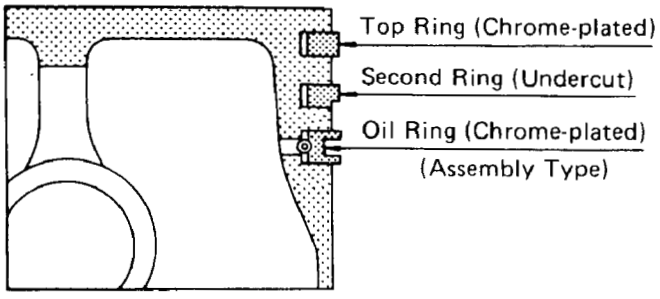


Fig. 25

5) Install the piston and connecting rod assembly. When installing the connecting rod into place, hold piston rings with the ring guide as shown in Fig. 26 (if no ring guide is available, keep pressing the piston ring, with finger tips and gently tap the top of the piston with a wooden piece or the like to push it in), and check that the symbol ❼ or the mark "MAG" on the connecting rod is in the direction of the flywheel magneto.

NOTE: Apply enough oil to the piston rings, connecting rod plain bearings, and cylinder wall before reassembling.

NOTE: The open ends of the piston rings must be 90° apart from one another on the piston periphery.

NOTE: The clearance between the piston and cylinder must be measured at the piston skirt thrust surface.

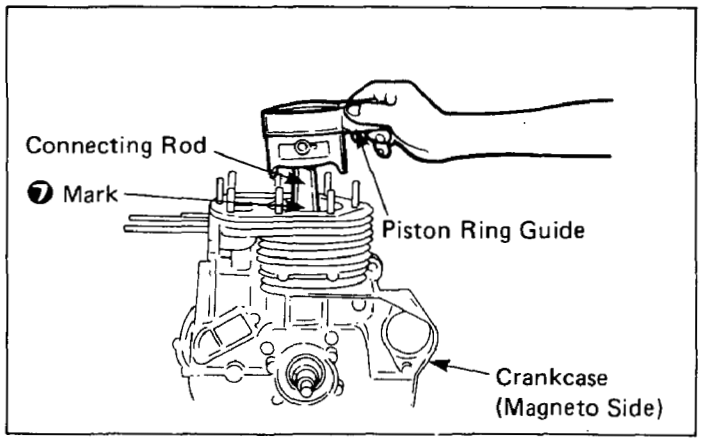


Fig. 26

6) Connecting rod tightening

Match the mark on the large end cap with that of the connecting rod large end, and install the large end cap.

Bolts: 8 x 46 mm

Tightening torque: 250 ~ 300 kg-cm

Use a new lock washer and be sure to bend the tabs.

7) Main bearing cover subassembly

Assemble the governor shaft, governor yoke, oil pump, holder (camshaft), and oil filter with the main bearing cover.

NOTE: Be careful not to damage the oil seal when installing the governor shaft.

NOTE: Remove dust, chips, etc. from the inside of the pump housing and apply engine oil to it before installing the oil pump.

Holder (camshaft) bolts: 6 x 25 mm with washer and spring washer

Holder (camshaft) tightening torque: 70 ~ 90 kg-cm

8) Side clearance measuring

Adjust the side clearances of the crankshaft and camshaft with the adjusting collars. Measure A, B, D, and E shown in Fig. 27, and select adjusting collars so that the side clearances of both the crankshaft and camshaft will be 0 to 0.25 mm.

NOTE: C indicates gasket thickness. Calculate it as 0.25 mm.

NOTE: Three kinds of adjusting collars—1.05 mm, 1.2 mm, and 1.35 mm thick—are available for both the crankshaft and camshaft.

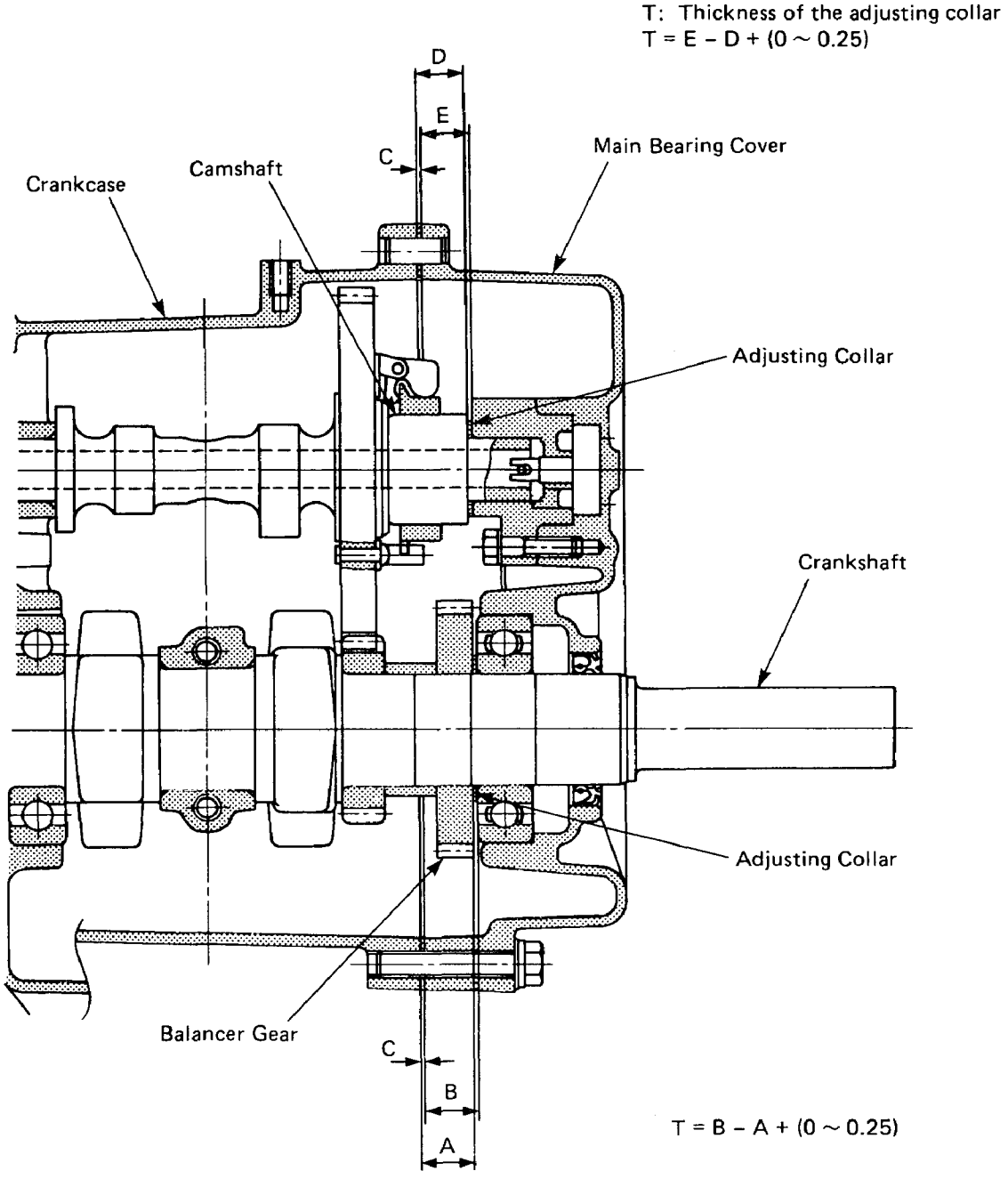


Fig. 27

9) Balancer mounting

Move the piston to the top dead center.

Engage balancer 1 with the crankshaft, and balancer 2 with balancer 1. (See Fig. 28.)

Match the match marks as shown in Fig. 28.

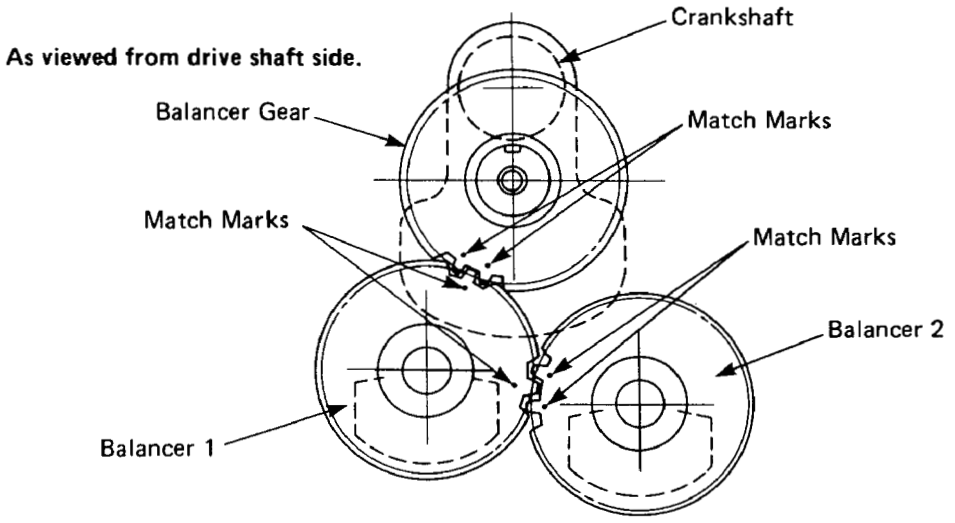


Fig. 28

10) Main bearing cover mounting

- Fit the governor sleeve on the camshaft; install the adjusting collars selected in Step 8), and install the main bearing cover assembly that was readied in Step 7).
- Move the piston to the top dead center, align the groove of the oil pump shaft that is installed in the main bearing cover with the camshaft holder groove as shown in Fig. 29, and mount the main bearing cover.

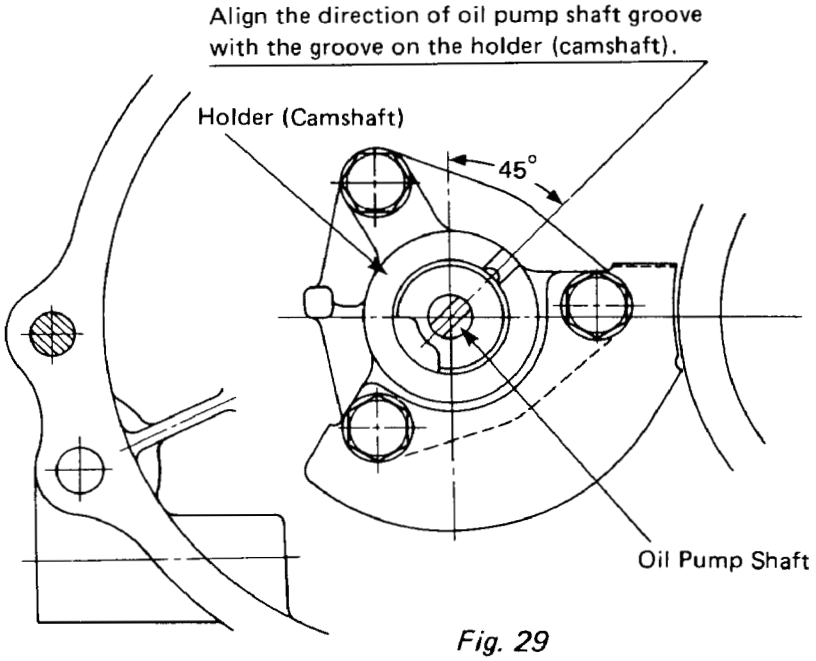


Fig. 29

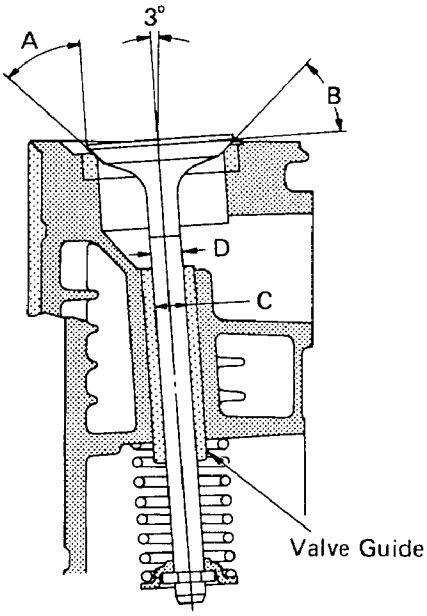
NOTE: Replace the gasket (main bearing cover) with a new one.

NOTE: Be careful not to damage the oil seal.

Bolts: 8 x 45 mm with washer and spring washer

Tightening torque: 170 ~ 190 kg-cm

11) Install the intake and exhuast valves.
*Intake and exhaust valve specifications are as follows:



VALVE and VALVE GUIDE CLEARANCE

A-VALVE FACE ANGLE		45°
B-SEAT ANGLE		45°
C-GUIDE INSIDE DIA.		8 dia. $^{+0.036}_{0}$ mm
D-VALVE STEM OUTSIDE DIA	INTAKE	8 dia. $^{-0.030}_{-0.055}$ mm
	EXHUAST	8 dia. $^{-0.070}_{-0.090}$ mm
MAXIMUM ALLOWABLE CLEARANCE BETWEEN C and D	INTAKE	0.030 L ~ 0.091 L
	EXHAUST	0.070 L ~ 0.126 L

L: Loose

Table 2

•TAPPET CLEARANCE ADJUSTMENT

Turn the crankshaft to compression TDC, and check the tappet clearance as follows.

Clearance: 0.08 ~ 0.12 mm when cold

If the clearance is too small, slightly grind the end of valve stem.

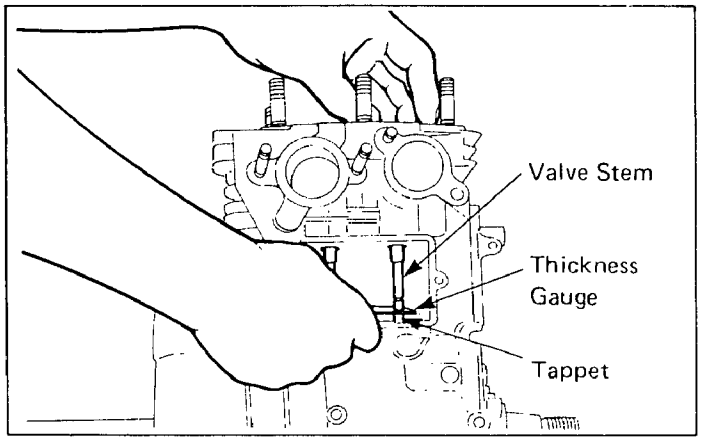


Fig. 30

*Intake and exhaust valve installation
Apply oil to the valve stems, and install the valves securely by using the valve spring retainer and pliers. (See Fig. 31.)
After their installation, check the tappet clearance again.

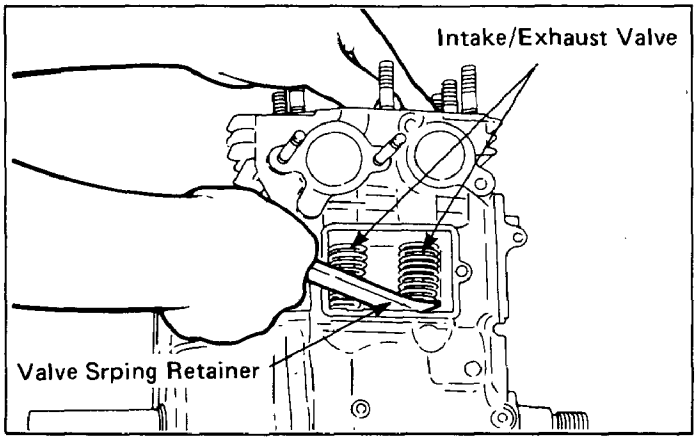


Fig. 31

12) Install the gasket and tappet cover.

13) Install breather plate and breather plate with gaskets.
NOTE: Make sure to use the correct gaskets.

14) Cylinder head
Replace the head gasket with a new one.
NOTE: The edge-folded side of the gasket must face the cylinder head.
Head nuts: 10 mm flange nuts
Tightening torque: 350 ~ 400 kg-cm

15) Spark plug
Tightening torque: 120 ~ 150 kg-cm

16) Electrical parts
a) Lighting coil
NOTE: Be sure to clamp the wire to prevent it contact with the flywheel.
6 x 20 mm screw and washer assembly

b) Flywheel
Clean the dust or oil from the tapered portion of the crankshaft and flywheel, and install the flywheel.
NOTE: Install the flywheel before the ignition coil.
Tightening torque: 800 ~ 1000 kg-cm

c) Ignition coil
Adjust the clearance (air gap) between the ignition coil and flywheel, and then tighten the ignition coil.
Air gap: 0.5 mm

d) Starter motor
8 x 30 mm reamer bolts with washer and spring washer
Tightening torque: 160 ~ 200 kg-cm

17) Blower housing and head cover

Install head cover, blower housing and cylinder baffle.

18) Rotating screen

Mount the rotating screeen with spacer.

8 x 50 mm bolts with washer and spring washer
Tightening torque: 160 ~ 200 kg-cm

19) Oil filler

Insert the oil filler into the main bearing cover, exercising care not to damage the O-ring at the bottom of the oil filler. Fasten the top of the oil filler with the oil filler clamp.

20) Intake manifold, carburetor, elbow, and air-cleaner

- Temporarily fasten the intake manifold, carburetor, elbow, air-cleaner, etc. and make sure that these parts are properly positioned relative to one another. Then tighten the bolts and nuts.
- Be sure to use the correct gasket on each flange. (See Fig. 32.)

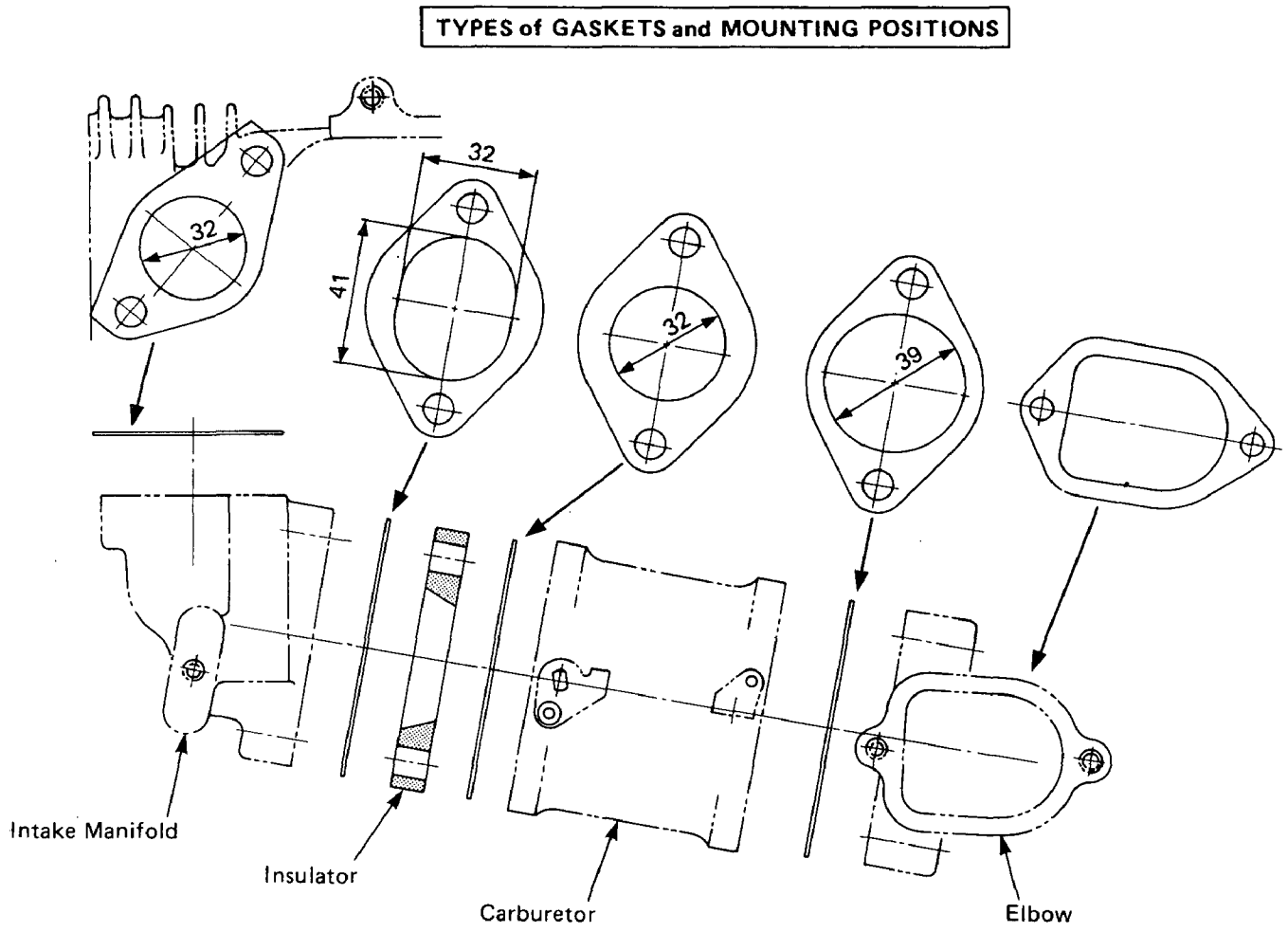


Fig. 32

a) Intake manifold

b) Insulator
Be careful of its mounting direction.

Intake manifold side
Carburetor side

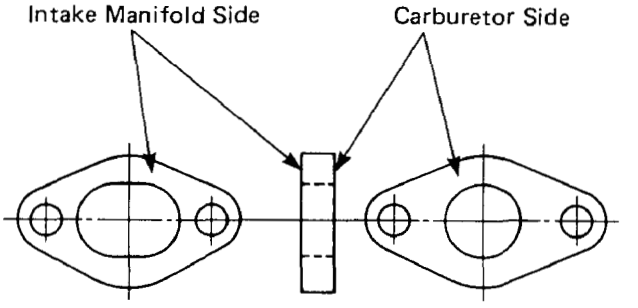


Fig. 33

c) Carburetor
- Pay attention to the types of gaskets on the front and back.
- Install the governor rod, rod spring, and choke rod.

d) Elbow and support (elbow)
Install the breather pipe between the crankcase and elbow.

e) Air-cleaner case
Place the air-cleaner case on the elbow and intake manifold, check that it is properly positioned relative to them, and tighten it.

f) Cleaner element, cleaner cover

21) Governor lever and speed control

a) Governor lever
Hook the governor rod and rod spring to the end of the governor lever, and install the lever on the governor shaft.

b) Speed control, governor spring
Hook the choke rod to the choke lever. Install the governor spring on the governor lever and speed control.

22) Governor set
Pull the speed control lever in the high speed direction, fully open the carburetor throttle valve, turn the governor shaft clockwise all the way, and tighten the governor lever bolt.

NOTE: The engine speed setting procedure is described in a separate section.

23) Muffler
Replace the muffler gasket with a new one, and install the muffler and muffler bracket.

Muffler nuts: M8 flange nuts (stainless steel)
Tightening torque: 180 ~ 220 kg-cm

After tightening the flange nuts, bend the tabs of the lock washers for the heat deflector to prevent the nuts from turning loose.

6. ENGINE SPEED SETTING

6-1 CHOKE and SPEED ADJUSTMENT

Operate the engine at no-load. Then, turn speed control lever toward "CHOKE" position until it just contacts the choke/R.P.M. adjusting screw on choke lever (do not move choke lever.).

To adjust the "CHOKE" start position and HIGH speed operating R.P.M., use a tachometer or revolution counter. Turn the adjusting screw in or out against the speed control lever until the desired no load operating speed is obtained. This same position will be the start of the 'CHOKE' operation.

6-2 TO INSTALL REMOTE CONTROL WIRE

1. Use a control wire suitable for a .098" (2.5 mm) diameter wire hole and .236" (6 mm) diameter casing hole.
2. Install control wire to engine by control wire bracket. Use pliers and pinch bracket around casing to secure in place.
3. Insert the end of control wire into the speed control lever.
4. Place speed control lever in "LOW SPEED" position and tighten control wire lockscrew.

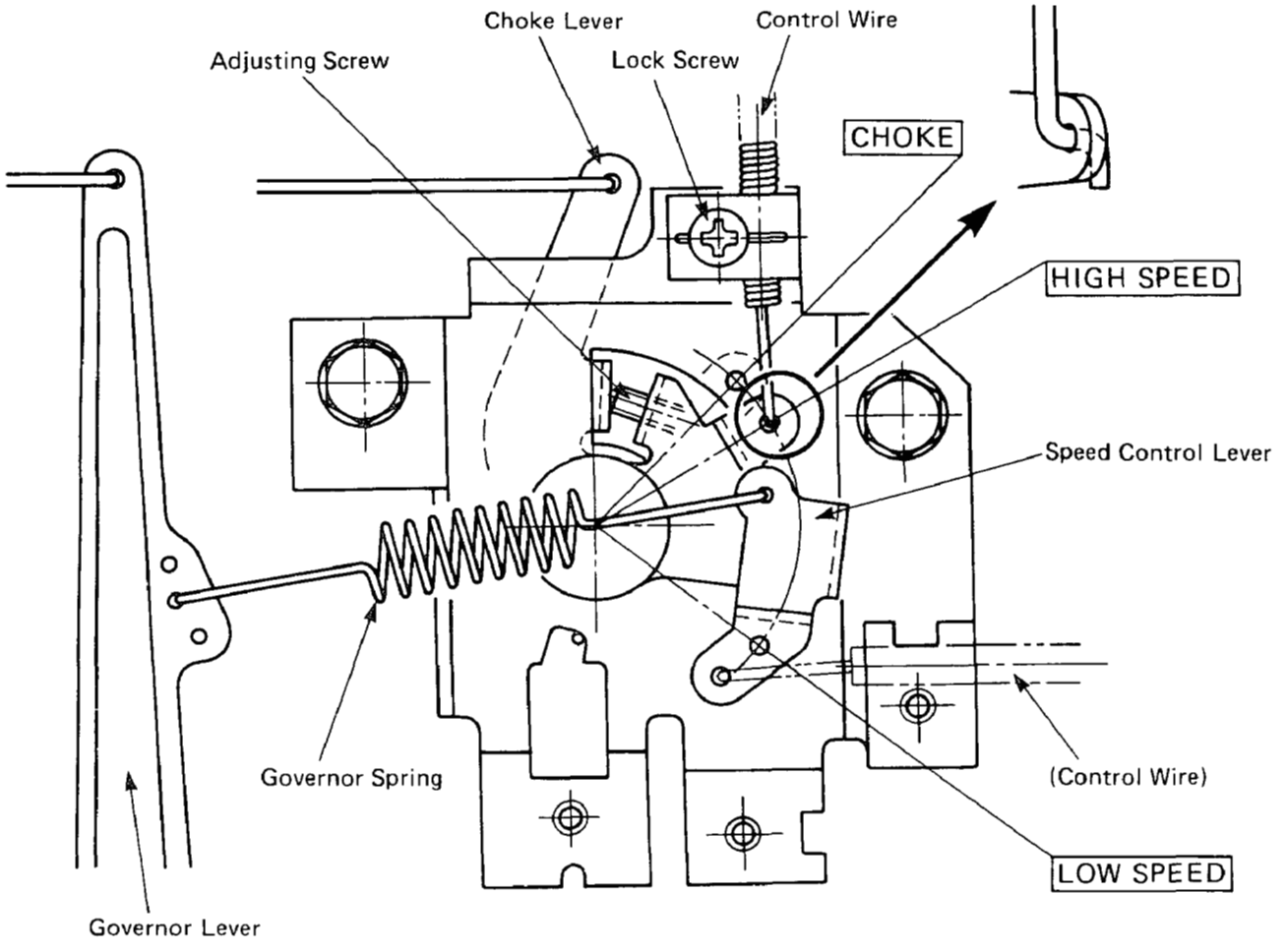


Fig. 34

7. MAGNETO

The pointless electronic ignition magneto consists of a flywheel and an ignition coil.

7-1 FEATURES

This system is outer coil type without pulser and is called T.I.C. (Transistor igntion circuit type). To the EY45V engine this T.I.C. is equipped as standard parts.
Being different from the breaker point type ignition system this brand-new system is completely free from such troubles as starting-up failure owing to dirty, burnt or corroded point surface, reduction of ignition efficiency being caused by moisture, rough surface of breaker point and incorrect timing resulted from worn mechanical parts.

7-2 BASIC THEORY of T.I.C. (See Fig. 35.)

T.I.C. (Transistor igntion type) consists of the flywheel and ignition coil with built-in transistor; and its basic theory is as follows:

1) Revolution of the flywheel generates electricity on the primary side of the ignition coil, and the electric current **A** flows. **A** turns the power transistor "ON" and the electric current **B** flows.
2) The flywheel goes round further, and at the time of ignition, the electric current **C** flows to turn the signal transistor "ON" to allow current **D**. At this moment the electric current **B**, passing through the power transistor, is abruptly shut; and as a result, the high voltage electricity is generated on the secondary side of the ignition coil and it produces sparks at the plug.

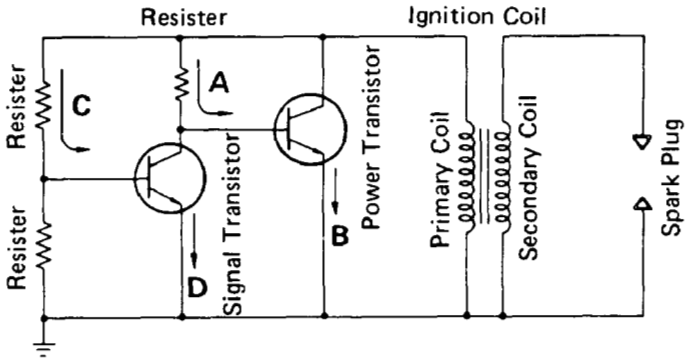


Fig. 35

7-3 WIRING DIAGRAM

The following parts are not supplied with eingine as standard equipments.

- STOP SWITCH
- MAGNETIC SWITCH
- STARTER SWITCH
- 12V BATTERY
- AC 12V LAMP

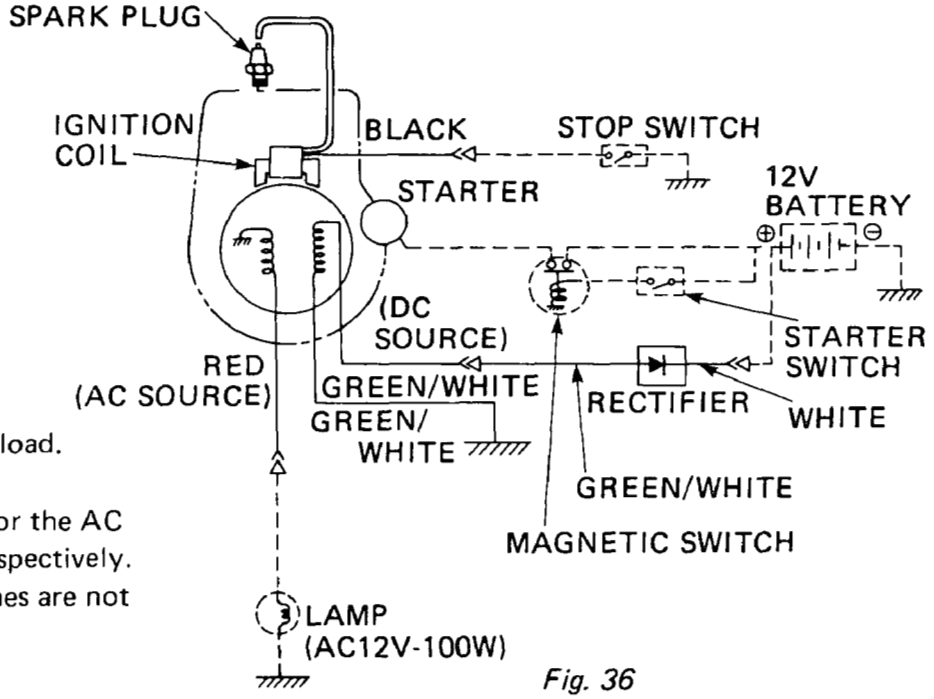


Fig. 36

NOTE: AC source is for 12V, 100W load. The lighting coil is optional.

NOTE: Rated and maximum loads for the AC source are 80W and 100W respectively.

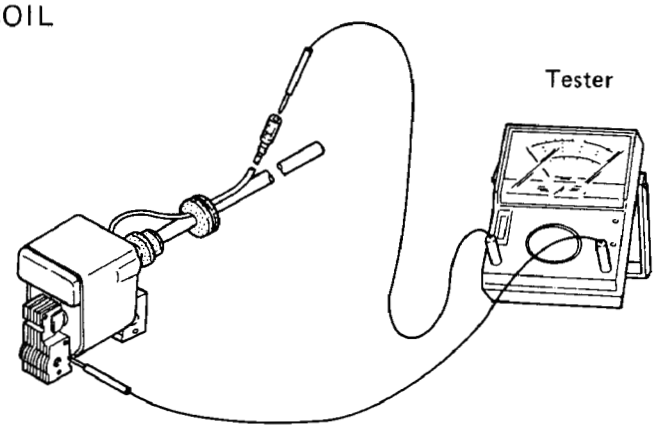
NOTE: Wires indicated by dotted lines are not supplied with engine.

7-4 CHECKING PROCEDURES

MEASURING RESISTANCES

7-4-1 IGNITION COIL

1) Primary Side

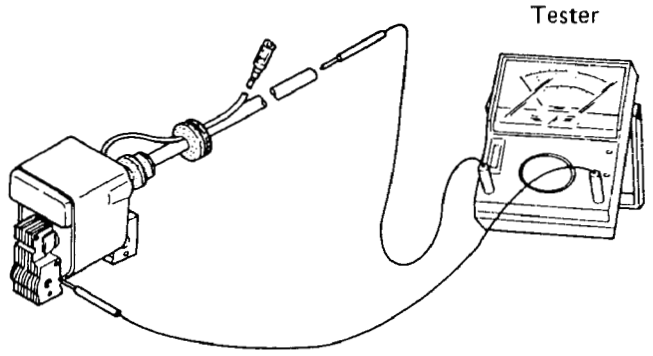


Note: The following resistance values are measured at 20°C.

Between stop lead and core

0.5 ~ 0.75Ω

2) Secondary Side

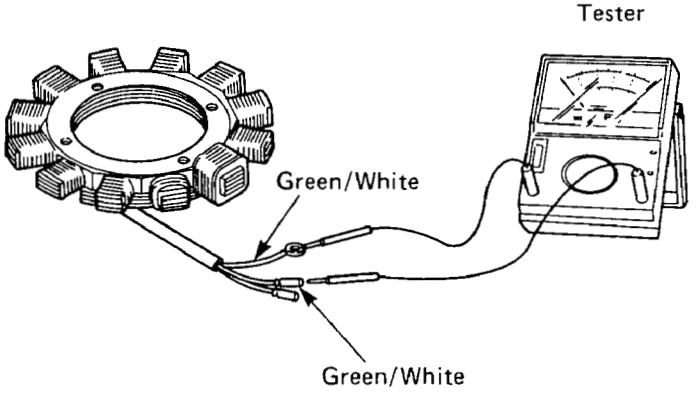


Between high tension cord and core

10 ~ 15Ω

7-4-2 LAMP COIL and CHARGE COIL

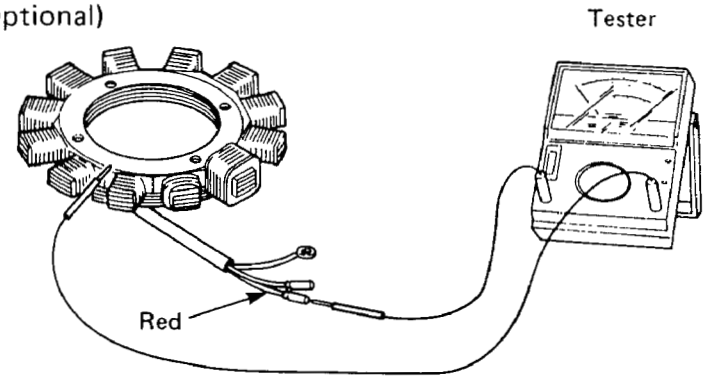
1) Charge Coil



Between Green/White cord and Green/White cord

0.9 ~ 1.3Ω

2) Lamp Coil (Optional)



Between red cord and core

0.8 ~ 1.3Ω

8. CARBURETOR

8-1 OPERATION and CONSTRUCTION (See Fig. 37 and 38.)

8-1-1 FLOAT SYSTEM

The float chamber is located just below the carburetor body and, with a float and a needle valve, maintains a constant fuel level during engine operation.
The fuel flows from the fuel tank into the float chamber through needle valve. When the fuel rises to a specific level, the float rises; and when its buoyancy and fuel pressure are balanced, the needle valve closes to shut off the fuel, thereby keeping the fuel at the predetermined level.

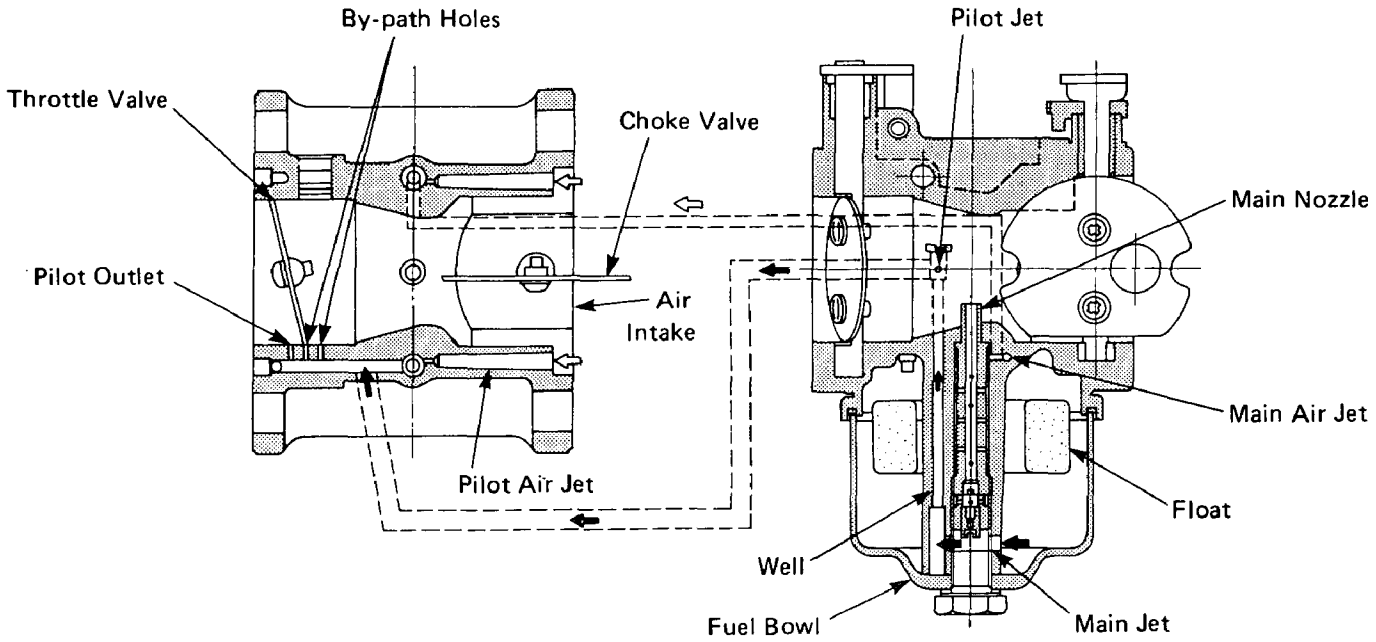


Fig. 37

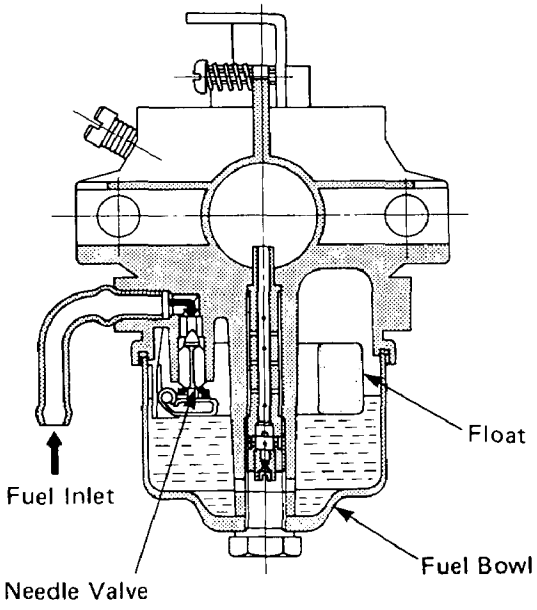


Fig. 38

8-1-2 PILOT SYSTEM

The pilot system feeds the fuel to the engine during idling and low-speed operation.
The fuel is fed through the main jet to the pilot jet, where it is metered, and mixed with the air metered by the pilot air jet.
The fuel-air mixture is fed to the engine through the pilot outlet and the by-pass.
At idling speed, the fuel is mainly fed from the pilot outlet.

8-1-3 MAIN SYSTEM

The main system feeds the fuel to the engine at medium- and high-speed operation.
The fuel is metered by the main jet and fed to the main nozzle. The air metered by the main air jet is mixed with the fuel through the bleed holes in the main nozzle, and the mixture is atomized out of the main bore. It is mixed again with the air taken through the air cleaner into an optimum fuel-air mixture, which is supplied to the engine.

8-1-4 CHOKE

The choke is used for easy start in the cold season. When the starter is operated with a closed choke, the negative pressure applied to the main nozzle increases and draws much fuel accordingly; thus easily start up the engine.

8-2 DISASSEMBLY and REASSEMBLY

Apart from mechanical failures, most of carburetor troubles are caused by an incorrect mixing ratio, which may arise mainly due to a clogged up air or fuel passage in jets, or fuel level variations. In order to assure proper flow of air and fuel, the carburetor must be kept clean at all times. The carburetor disassembly and reassembly procedures are as follows: (See Fig. 39.)

8-2-1 THROTTLE SYSTEM

1) Remove the Philips screw (5) and throttle valve (4), and pull out the throttle shaft (9).
2) The spring (12) can be taken out by removing the throttle stop screw (13).
   *Exercise care not to damage throttle valve ends.

8-2-2 CHOKE SYSTEM

1) Remove the Philips screw (2) and choke valve (3), and pull out the choke shaft (7).
2) When reassembling the choke shaft, make sure that the cutout in the choke valve faces the main air jet.
   Meantime, when reassembling set the rings (8) and (14) at the right position.

8-2-3 PILOT SYSTEM

1) Remove the pilot jet (6), using correct tool to avoid damage to it.
2) Reassembly
   Tighten the pilot jet securely. Otherwise, the fuel may leak, causing engine malfunction.

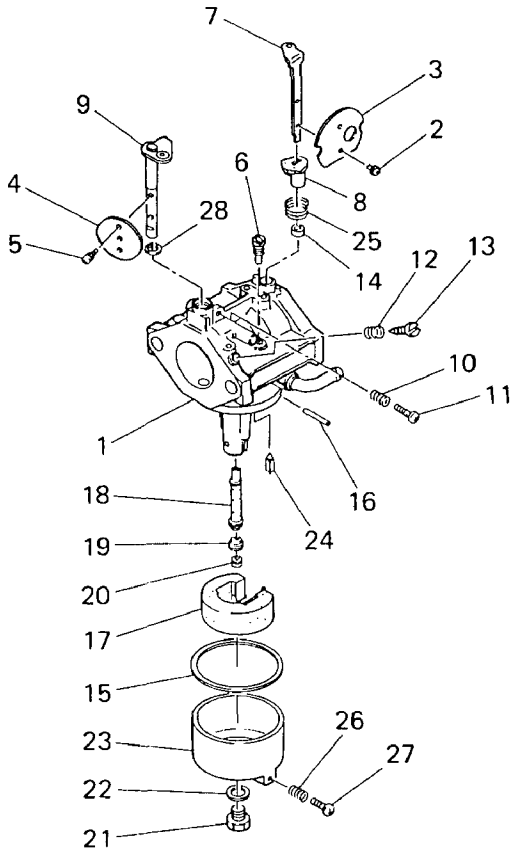


Fig. 39

8-2-4 MAIN SYSTEM

1) Remove the bolt (21) and take out float chamber body (23).
2) From the body (1) remove the main nozzle (18), and then remove the main jet (20) from the main nozzle (18).
3) Reassembly
   a) Fasten the main jet securely to the body. Otherwise, the fuel may become too rich and cause engine malfunction.
   b) The bolt tightening torque is 70 kg-cm.

8-2-5 FLOAT SYSTEM

1) Pull out the float pin (16) and remove the float (17) and needle valve (24). If the needle valve need be replaced, replace it with rubber needle.
   Caution: When cleaning the jets, use neither a drill nor a wire (because of possible damage of the orifice which will adversely affect fuel flow). Be sure to use compressed air to blow them clean.
2) When removing the needle valve and flots, gently tap the reverse side using the rod more slender than the float pin and remove because the float pin is calked to the carburetor body.

9. STARTING MOTOR

9-1 DISASSEMBLY

1) Remove 5 mm terminal nuts. (2 pcs.)

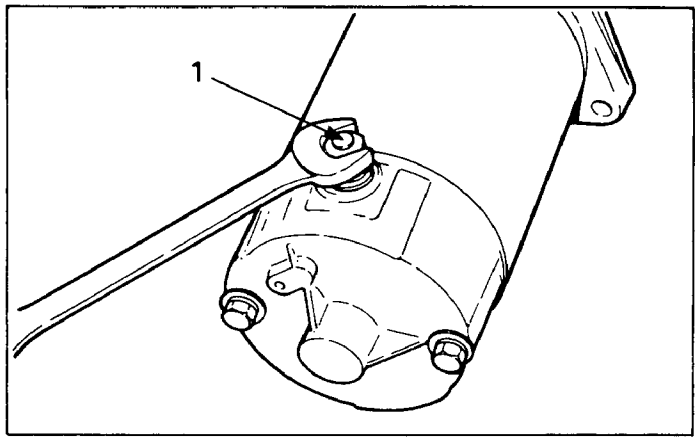


Fig. 40

2) Remove 5 mm through bolts. (2 pcs.)
3) Remove terminal bush.

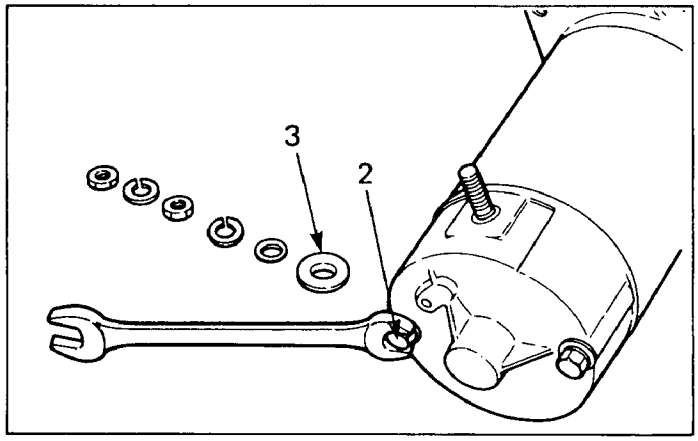


Fig. 41

4) Remove rear cover.

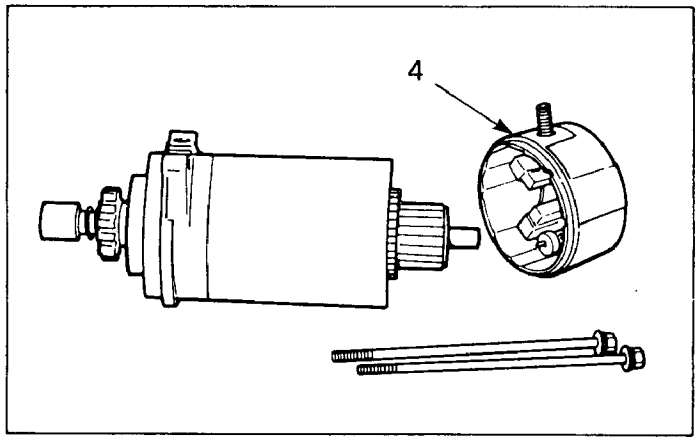


Fig. 42

5) Remove 4 mm Screws. (2 pcs.)

6) Remove Brush Holder.

7) The brush holder is disassembed by removing the 4 mm screws. (2 pcs.)
Remove the Terminal Bush No. 2.

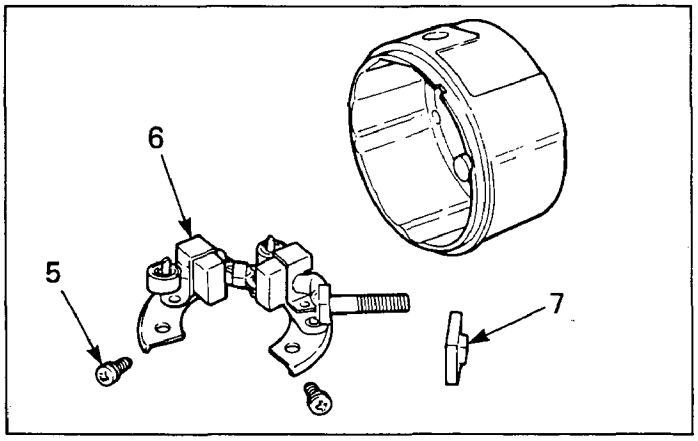


Fig. 43

8) Yoke Assembly
Remove yoke assembly.

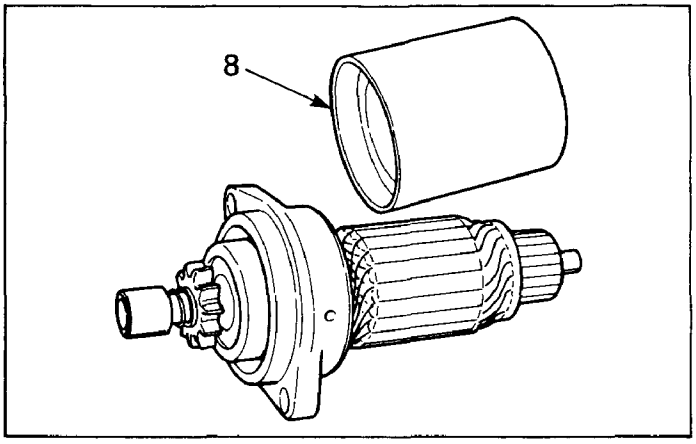


Fig. 44

9) The pinion stopper clip is removed with a standard screwdriver while the pinion stopper is pushed toward the pinion.

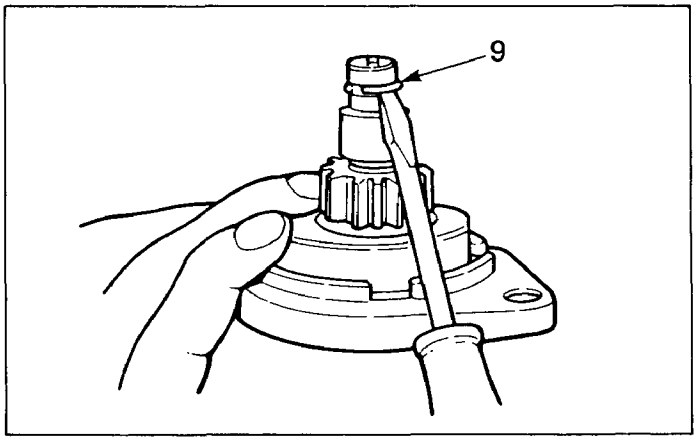


Fig. 45

10) Disassemble pinion stopper 10, pinion return spring 11 and pinion assembly 12.

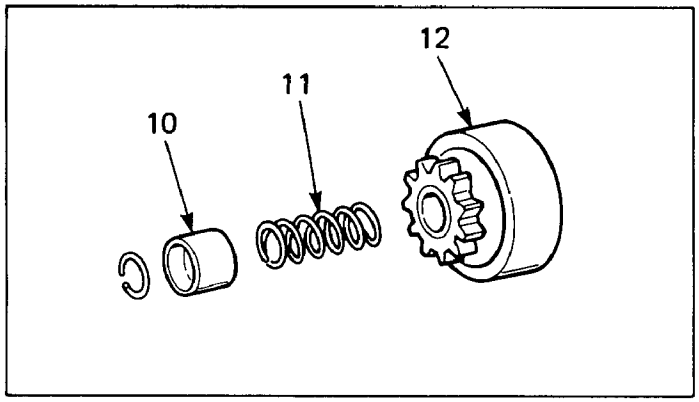


Fig. 46

11) Disassemble armature 13, thrust washer 14 and front cover 15.

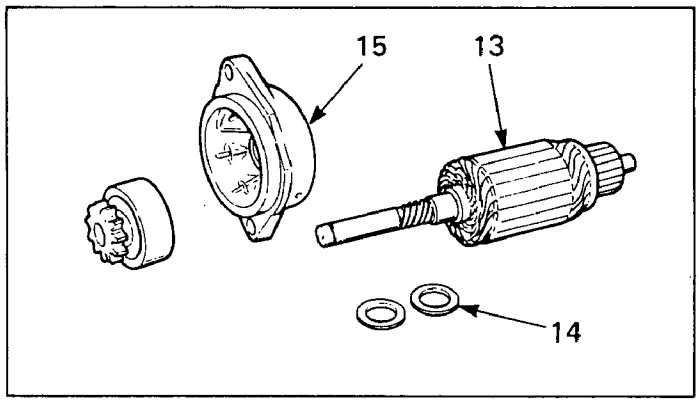
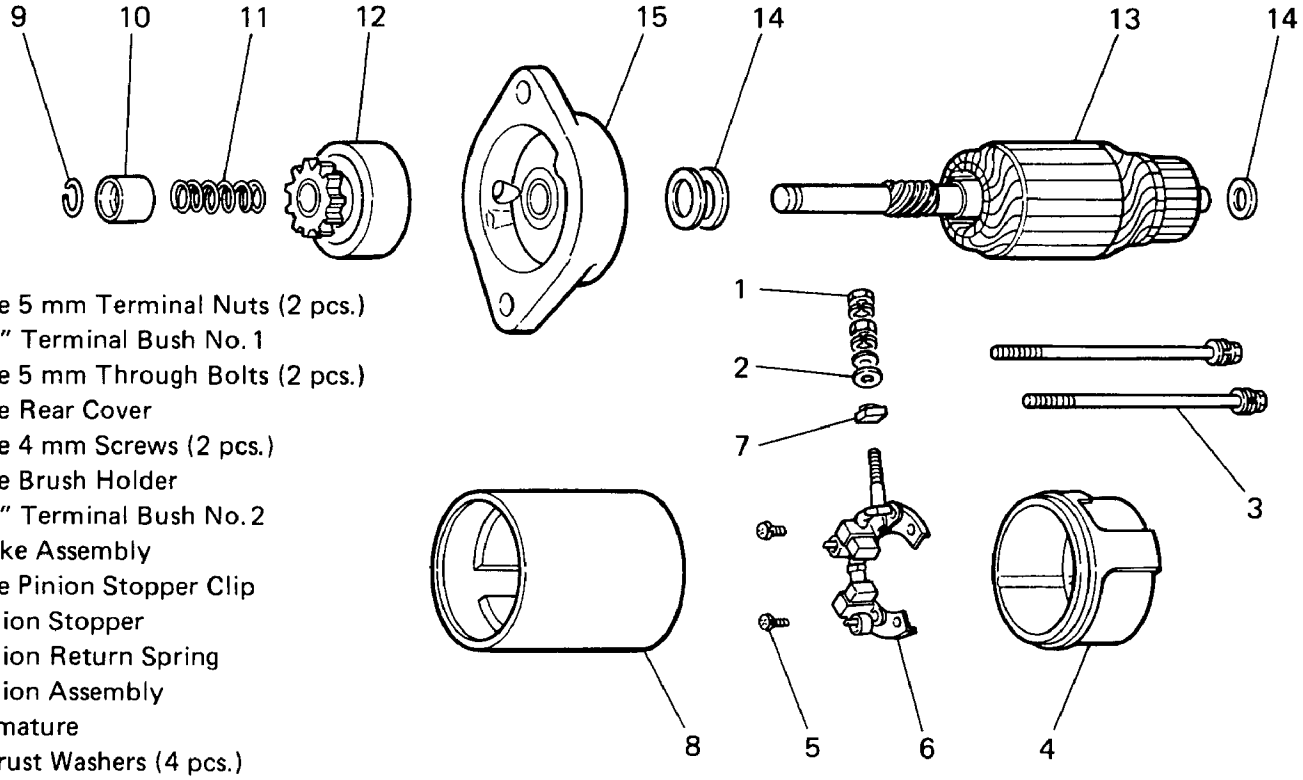


Fig. 47



1) The 5 mm Terminal Nuts (2 pcs.)
2) "M" Terminal Bush No. 1
3) The 5 mm Through Bolts (2 pcs.)
4) The Rear Cover
5) The 4 mm Screws (2 pcs.)
6) The Brush Holder
7) "M" Terminal Bush No. 2
8) Yoke Assembly
9) The Pinion Stopper Clip
10) Pinion Stopper
11) Pinion Return Spring
12) Pinion Assembly
13) Armature
14) Thrust Washers (4 pcs.)
15) Front Cover

Fig. 48

9-2 INSPECTION and REPAIR

9-2-1 ARMATURE

1) Check the diameter of the commutator.
If the outside diameter of the commutator is smaller than the limit, then replace armature with a new one.

Standard (New)	Limit (Used)
30 mm	29 mm

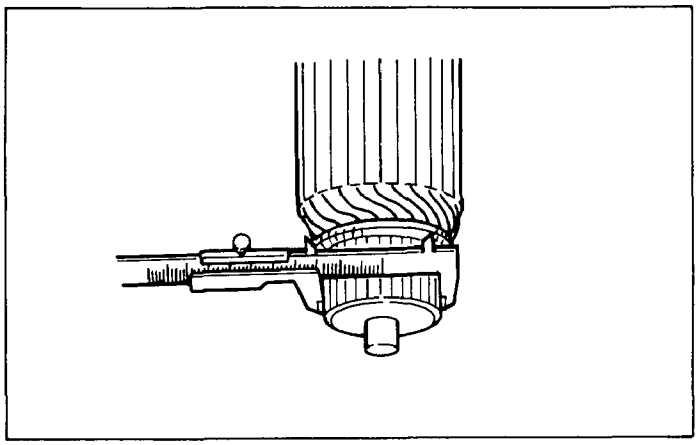


Fig. 49

2) Continuity Test for the Armature Coil
Use a tester to check for continuity between parallel points on the commutator. If there is continuity, the armature is good.

No continuity: (broken coil)
Replace the armature unit.

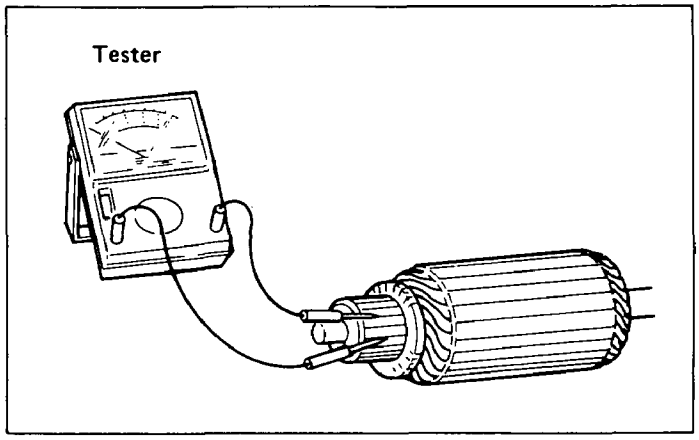


Fig. 50

3) Insulation Test for the Armature Coil
Use a tester to check for continuity between a point on the commutator and the shaft or the core. If there is no continuity, the armature is good.

Continuity Exists: (Short circuited coil)
Replace the armature.

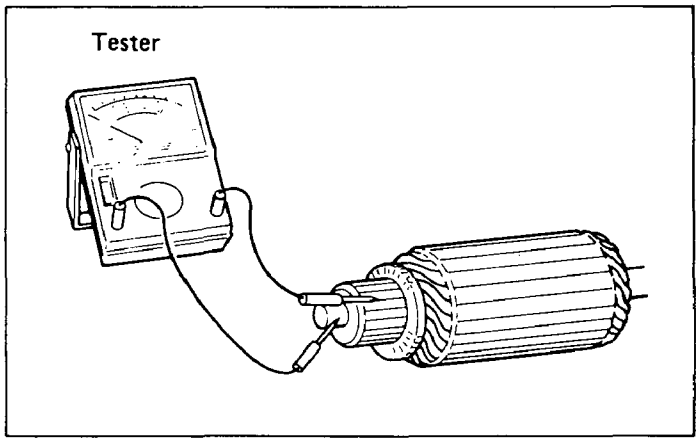


Fig. 51

4) Check for Surface Distortion on the Armature and the Commutator
Use a dial gauge to measure the distortion of the outside surfaces of the armature core and the commutator. If it is above the limit, then repair or replace it.

(mm)

	Standard (New)	Limit (Used)
Armature	0.05 (Max.)	0.1 (Max.)
Commutator	0.05 (Max.)	0.1 (Max.)

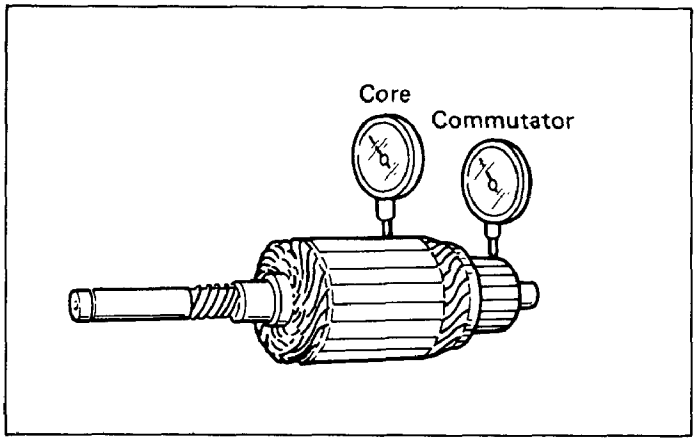


Fig. 52

5) Check the Surface of the Commutator
If the commutator surface is rough, polish it with fine sandpaper (# 500 ~ 600).

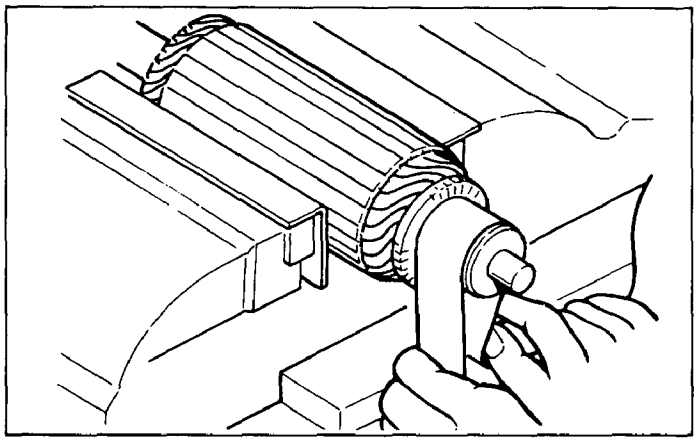


Fig. 53

6) Check the Depth of the Insulating Material from the Commutator Surface
If the depth of the insulating material from the commutator segments is less than the limit, repair it by filing it down.

(mm)

Standard (New)	Limit (Used)
0.5 ~ 0.8	0.2 (Min.)

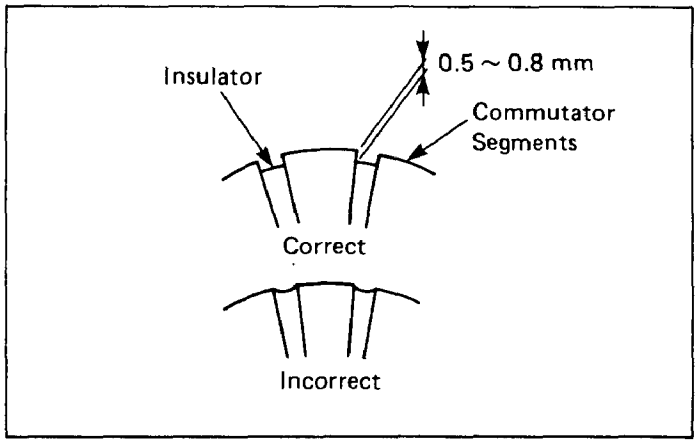


Fig. 54

9-2-2 BRUSH

Measure the length of the brushes and if they are shorter than the limit, replace them.

Standard (New)	Limit (Used)
12.5 mm	9 mm

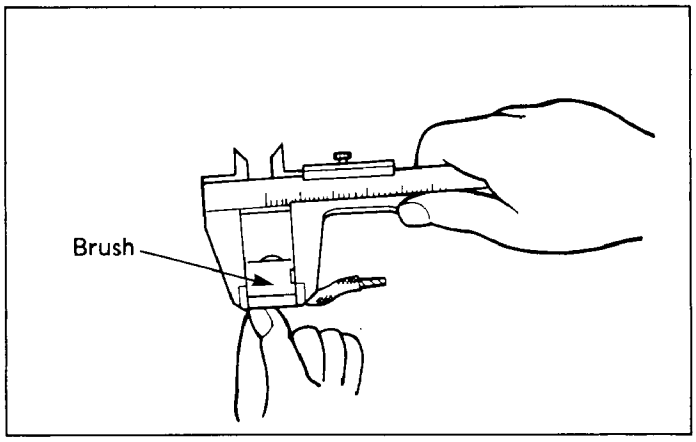


Fig. 55

9-2-3 BRUSH HOLDER

1) Insulation Test for the Brush Holder
   Check for continuity between the brush holder's top (positive side) and its base (negative side). If there is no continuity, then it is good.

   Continuity Exists: (Insulation failure)
   Replace brush holder.

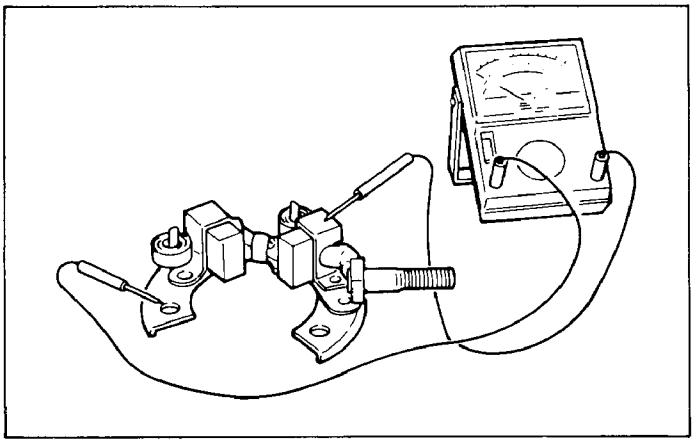


Fig. 56

2) Inspection of the Brush Springs
   Check the return force of the brush springs.

Normal force (kg)
1.4 ~ 1.8

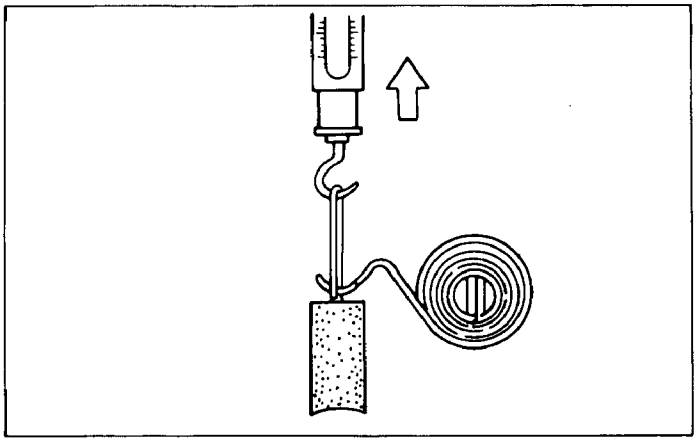


Fig. 57

9-2-4 PINION CLUTCH

Inspection of the Pinion Clutch
Rotate the pinion manually. While rotating it in the direction of normal operation, smoothly reverse the direction of rotation to confirm that it locks.
In the event of any irregularity, replace it.

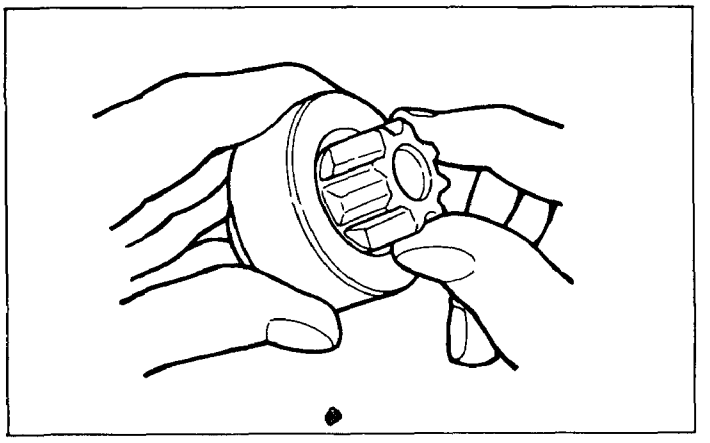


Fig. 58

9-3 REASSEMBLY

Reassembly is in the reverse order of disassembly, however, please note the following points.

The Places to Apply Grease:

The sliding surfaces of the pinion and the shaft's spline.
The metals holding the shaft at the front and rear covers.

10. BREAK-IN OPERATION of REASSEMBLED ENGINE

An overhauled engine must be operated at low speed to break-in the parts. A thorough break-in is indispensable particularly when the cylinder, piston, piston rings or valves are replaced with new ones.
The recommended break-in schedule is shown below.

LOAD EY45V	SPEED	TIME
NO LOAD	2,500 rpm	10 minutes
NO LOAD	3,000 rpm	10 minutes
NO LOAD	3,600 rpm	10 minutes
4.5HP	3,600 rpm	30 minutes
9.0HP	3,600 rpm	60 minutes

11. TROUBLESHOOTING

The following three conditions must be satisfied for satisfactory engine start.

1. The cylinder filled with a proper fuel-air mixture.
2. An appropriate compression in the cylinder.
3. Good sparks at the correct time to ignite the mixture.

The engine cannot be started unless these three conditions are met. There are also other factors which make engine start difficult, e.g., a heavy load on the engine when it is about to start at low speed, and a high back pressure due to a long exhaust pipe, just to say a few.

The most common causes of engine troubles are given below:

11-1 STARTING DIFFICULTIES

11-1-1 FUEL SYSTEM

1) No gasoline in the fuel tank; or the fuel cock is closed.
2) The carburetor is not choked enough, particularly when the engine is cold.
3) Water, dust or gum in the gasoline blocks the fuel flow to the carburetor.
4) Inferior grade gasoline or poor quality gasoline is not vaporized enough to produce the correct fuel-air mixture.
5) The carburetor needle valve is held open by dirt or gum. This trouble can be detected as the fuel flows out of the carburetor when the engone is idling. (Overflow)
   This trouble may be remedied, depending on cases, by lightly tapping the float chamber with the grip of a screwdriver or the like.
6) If the carburetor overflows, excessive fuel runs into the cylinder when starting the engine, making the fuel-air mixture too rich to burn. If this happens, remove the spark plug, and turn the starting pulley a few turns in order to let the rich fuel-air mixture out of the spark pulg hole into the atmosphere. Keep the carburetor choke open during this operation. Dry the spark plug well, screw it into place, and try to start again.

11-1-2 COMPRESSION SYSTEM

If starting difficultes and loss of power are not due to the fuel system or ignition system, the followings must be checked for possible lack of compression.

1) Engine inside is completely dried up because of a long period of non-operation.
2) Loose or broken spark plug. This causes a hissing noise made by mixture gas running out of cylinder in compression stroke during cranking.
3) Damaged head gasket or loose cylinder head. A similar hissing noise is produced during compression stroke.
4) Incorrect Tappet Clearance
   If the correct compression is not obtained even after remedying the above, disassemble the engine and check further as follows:
   a) Valve stuck open due to carbon or gum on the valve stem.
   b) If the piston rings are stuck on the piston, remove the piston and connecting rod from the engine, and clean, remedy or replace the parts.

11-1-3 ELECTRICAL SYSTEM

Check the followings for lack of sparks.

1) Leads of the ignition coil, spark plug or contact breaker disconnected.
2) Ignition coil damaged and shorted.
3) Spark plug cable wet or soaked with oil.
4) Spark plug dirty or wet.
5) Spark plug electrode gap incorrect.
6) Spark plug electrodes are connected or bridged.
7) Incorrect spark timing.

11-2 ENGINGE MIFIRES.

1) Incorrect spark plug electrodge gap. Adjust it to anywhere between 0.6 and 0.7 mm.
2) Ignition cable worn and leaking.
3) Sparks weak.
4) Ignition wire connections loose.
5) Water in gasoline.
6) Insufficient compression.

11-3 ENGINE STOPS.

1) Fuel tank empty. Water, dirt, gum, etc. in gasoline.
2) Vapor lock, i. e., gasoline evaporating in the fuel lines due to overheat around the engine.
3) Vapor lock in the fuel lines or carburetor due to the use of too volatile winter gas in the hot season.
4) Air vent hole in the fuel tank cap plugged.
5) Bearing parts seized due to lack of oil.
6) Magneto or ignition coil faulty.

11-4 ENGINE OVERHEATS.

1) Crankcase oil level low. Add oil immediately.
2) Spark timing incorrect.
3) Low grade gasoline is used, or engine is overloaded.
4) Cooling air circulation restricted.
5) Cooling air path misdirected causes loss of cooling efficiency.
6) Cylinder head cooling fins clogged up with dirt.
7) Engine operated in an enclosed space without fresh supply of cooling air.
8) Exhaust gas discharge restricted, or carbon deposits in the combustion chamber.
9) Engine running on low-octane gaoline detonates due to heavy load at low speed.

11-5 ENGINE KNOCKS.

1) Low-quality gasoline.
2) Engine operating under heavy load at low speed.
3) Carbon or lead deposits in the cylinder head.
4) Spark timing incorrect.
5) Loose connecting rod bearing due to wear.
6) Loose piston pin due to wear.
7) Cuases of engine overheat.

11-6 ENGINE BACKFIRES through CARBURETOR.

1) Water or dirt in gasoline, or low-grade gasoline.
2) Intake valve stuck.
3) Valves overheated, or red-hot carbon particles in the combustion chamber.
4) Engine cold.

12. INSTALLATION

Engine life, ease of maintenance and inspection, frequency of checks and repairs, and operating cost all depend on the way in which the engine is installed. Carefully observe the following instructions for installing the engine.

12-1 INSTALLING

When mounting the engine, carefully examine its position, the method of connecting it to a load (machine), the foundation, and the mehtod of supporting the engine.
When determining its mounting position, in particular, make sure that gasoline and oil can easily be supplied and checked, the spark plug can easily be checked, the air cleaner can easily be serviced, and that the oil can easily be discharged.

12-2 VENTILATION

Fresh air is necessary for cooling the engine and burning the fuel.
In case where the engine is operated under a hood or in a small room, temperature rise in the engine room can cause vapor lock, oil deterioration, increased oil consumption, loss of power, piston seizure, shorter engine life, etc., making it impossible to operate the engine properly. It is necessary, therefore, to provide a duct or baffle to guide cooling air to the engine to prevent recirculation of he hot air used for engine cooling, and temperature rise of the load (machine).
Take steps as necessary to keep the engine room temperature below 50°C even in the hottest period of the year.

12-3 EXHAUST GAS DISCHARGE

Exhaust gas is noxious. When operating the engine indoors, be sure to discharge the exhaust gas outdoors. If a long exhaust pipe is used in such a case, the internal resistance increases causing loss of engine power. Thus pipe inside diameter must increase in proportion to exhaust pipe length.

Exhaust pipe: Less than 3 m long, pipe inside diameter 25 mm,
Less than 5 m long, pipe inside diameter 30 mm.

12-4 POWER TRANSMISSION to DRIVEN MACHINES

12-4-1 BELT DRIVE

Take the following notes into consideration.

* V-belts are preferable to flat belts.
* The driving shaft of the engine must be parallel to the driven shaft of the load.
* The driving pulley of the engine must be in line with the driven pulley of the load.
* Install the engine pulley as close to the engine as possible.
* If possible, span the belt horizontally.
* Disengage the load when starting the engine.

If no clutch is used, use a belt tension pulley or the like.

12-4-2 FLEXIBLE COUPLING

When using a flexible coupling, runout and misalignment between the driven shaft and engine shaft must be minimized. Runout and misalignment tolerance are specified by the coupling manufacturer.

13. CHECKS and CORRECTIONS

After disassembling and cleaning the engine, check and repair, if necessary, according to the correction table. The correction table apolies whenever the engines are repaired. It is important for the servicemen to be familier with the contents of this table. Correct maintenance is recommended by observing the correction standards specified.

The meanings of the terms used in the correction table are as follows:

1) Correction
   Repair, adjustment or replacement of any engine parts.
2) Correction Limit
   The limit on wear, damage or functional deterioration of engine parts beyond which normal engine performance cannot be expected without repairing such parts.
3) Use Limit
   The limit beyond which parts can no longer be used in respect of performance or strength.
4) Standard Dimensions
   The design dimensions of new parts minus tolerance.
5) Correction Tolerance
   Tolerance on the dimensions of engine parts refinished or adjusted.

14. TABLE of CORRECTION STANDARDS

ITEM		STANDARD SIZE	CORRECTION		USE LIMIT	REMARKS	TOOL	CORRECTION METHOD
			TOLERANCE	LIMIT				
Flatness of cylinder head			0.05	0.15			Surface plate, Feeler	Correct
Cylinder	Bore	90 dia.	Dif. between max. & min. +0.006 −0.016	0.15	0.65		Cylinder gauge	Boring
	Roundness		0.01					
	Cylindricity		0.015					
	Valve seat contact width		1.2~1.5	2.5				Correct
	Valve guide I.D.	8 dia.	+0.036 0	0.15	0.15	At middle portion	Cylinder gauge	Replace
Piston	O.D. at skirt, in thrust direction (incl. over size) B 0.25 C 0.5	STD 89.973 dia. B 90.223 dia. C 90.473 dia.	0 −0.02	−0.1	−0.1		Micro-meter	Replace
	Width of ring groove	Top, 2nd: 2.5 Oil: 4	Top +0.06 ~ +0.04 2nd +0.04 ~ +0.02 Oil +0.04 ~ +0.02	0.15	0.15		Vernier calipers	Replace
	Piston pin hole	20 dia.	+0.002 −0.011	0.035	0.035		Cylinder gauge	
	Clearance between piston and cylinder		0.053 ~ 0.011		0.25	Max. cylinder dia. and piston dia. at skert in thrust direction	Cylinder gauge, Micro-meter	Replace
	Clearance between pisition ring and ring groove		Top 0.15 ~ 0.11 2nd 0.10 ~ 0.06 Oil 0.05 ~ 0.01	0.15	0.15		Feeler gauge	Replace
	Fit between piston and piston pin		0.011 T 0.011 L				Cylinder gauge, Micro-meter	
Piston Ring	Ring gap		Top, 2nd, Oil ┐ 0.3 ~ 0.1 ┘	1.5	1.5			Replace
	Ring width	Top, 2nd: 2.5 Oil: 4	Top −0.07 ~ −0.09 2nd −0.04 ~ −0.06 Oil +0.01 ~ −0.01	−0.1	−0.1		Mircro-meter	

ITEM		STANDARD SIZE	CORRECTION		USE LIMIT	REMARKS	TOOL	CORRECTION METHOD
			TOLERANCE	LIMIT				
Piston pin O.D.		20 dia.	0 ~ -0.009	-0.03	-0.03		Micro-meter	Replace
Connecting Rod	Large end I.D.	38 dia.	+0.016 ~ 0	0.1	0.1		Cylinder gauge	Replace
	Clearance between rod large end I.D. and crankpin		0.050 ~ 0.082	0.2	0.2		Cylinder gauge, Micro-meter	Replace
	Small end I.D.	20 dia.	+0.023 ~ +0.010	0.08	0.08		Cylinder gauge	Replace
	Clearance between small end I.D. and pinston pin		0.010 ~ 0.032	0.12	0.12		Cylinder gauge, Micro-meter	Replace
	Large end side clearance		0.1 ~ 0.3	1.0	1.0		Feeler gauge	Re-machine or Replace
	Parallelism between large end and small end bores		0.06	0.1	0.1		Test bar and Dial gauge	Re-machine or Replace
	Distance between large end and small end bores	120	±0.1		0.15		Test bar and Micro-meter	Replace
Crankshaft	Crankpin O.D.	38 dia.	-0.050 ~ -0.066	0.15	0.5		Micro-meter	Re-machine or Replace
	Crankpin O.D. roundness		Less than 0.005				Micro-meter	Re-machine or Replace
	Crankpin O.D. cylindricity		Less than 0.005				Micro-meter	Re-machine or Replace
	Crankpin O.D. parallelism		Less than 0.01				Dial gauge	Re-machine or Replace
	Crankshaft journal O.D.	PTO Side Magneto Side 35 dia.	-0.003 -0.014	0.05	0.05		Micro-meter	Replace
Camshaft	Cam lobe height	Intake 36 Exhaust 35.5	±0.1	-0.25	-0.25		Micro-meter	Replace
	Journal O.D.	PTO Side Magneto Side 20 dia.	-0.020 ~ -0.033	0.05	0.05		Micro-meter	Replace

ITEM		STANDARD SIZE	CORRECTION		USE LIMIT	REMARKS	TOOL	CORRECTION METHOD
			TOLERANCE	LIMIT				
Valve spring	Free length	46		-1.5	-1.5		Vernier calipers	Replace
	Squareness				1.0	For total length	Square feeler gauge	Replace
Intake & Exhaust Valves	Valve stem O.D.	Intake 8 dia.	-0.030 -0.055	-0.15			Micro-meter	Replace
		Exhaust 8 dia.	-0.070 -0.096					
	Clearance between stem and guide	Intake	0.030~0.091	0.3	0.3	At middle	Cylinder gauge	Replace
		Exhaust	0.070~0.126					
	Tappet clearance		When cold 0.10 ±0.02	below 0.05 above 0.25			Feeler gauge	Correct
	Clearance between groove and retainer		0.04~0.15				Feeler gauge	Replace
	Stem end length	5.3		-0.5	-0.5		Vernier calipers	Replace
Tappet	Total length	57	+0.06 ~ 0	-0.5	-0.5		Vernier calipers	Replace
	Clearance between stem and guide		0.025~0.062	0.2	0.2		Cylinder gauge & Micro-meter	Replace
Pilot screw unscrew			±1/4					
Electric Device	Spark plug	NGK BPM6A						
	Spark gap		0.6 ~ 0.7	1.0			Feeler gauge	Adjust or replace
	Spark timing	23° before T.D.C.	±3°				Timing tester	Adjust
	Clearance between Flywheel and Ignition Coil	0.5	±0.2				Feeler gauge	Adjust

ITEM	HP/rpm	USE LIMIT	REMARKS
Max. Output	12.0/3600	Below 110% of rated output	
Continuous Rated Output	9.0/3600		

ITEM	liter/hr	CORRECTION PRECISENESS	REMARKS
Fuel Consumption	4.0	Above 135% of standard consumption	At continuous rated output

ITEM	cc/hr	USE LIMIT cc/hr	REMARKS
Lubricant Consumption	10 ~ 15	40	Single grade oil

ITEM	liter	REMARKS
Fixed quantity of Lubricant	1.3	

☆Use the SC or higher grade engine oil.

	Comparison between oil viscosity and temparature	REMARKS
Specified Lubricant Quality	Single grade: 5W, 10W, 20W, #20, #30, #40 Multi-grade: 10W–30 −20 −10 0 10 20 30 40°C −4 14 32 50 68 86 104°F	When the peripheral temperature is below −20°C, use the oil of viscosity and quality fitted to the local conditions. When the peripheral temperature is above 40°C, use the oil of viscosity and quality fitted to the local conditions. The oil consumption is apt to increase, when used under high peripheral temparature, so it is necessary to check every day.

*If quality and quantity of the engine oil become lower or less, burning might be caused.

ITEM	FREQUENCY OF OIL CHANGE
Oil Change	First time: Change oil after 20 hours operation. Second Time and Thereafter: Change oil every 50 hours operation.

ITEM	kg/cm²/rpm	CORRECTION LIMIT	TOOL	REMARKS
Cylinder pressure	7.0~7.5/800	70% of normal value and down	Pressure gauge	

ITEM	rpm	TOOL	REMARKS
Min. accelerating revolution	2000	Tachometer	Crankshaft

	ITEM	kg-cm	ft-lb	TOOL	REMARKS
Tightening Torque	Cylinder head clamp nuts	340~390	24.6~28.3	Torque wrench	
	Connecting rod bolts	250 ~ 300	18~21.7	Torque wrench	
	Magneto clamp nuts	800~1000	57.9~72.3	Torque wrench	
	Main bearing cover bolts	170~190	12.3~13.7	Torque wrench	
	Spark plug	120~160	8.7 ~ 11.6	Torque wrench	

15. MAINTENANCE and STORING

The following maintenance jobs apply when the engine is operated correctly under normal conditions. The indicated maintenance intervals are by no means guarantees for maintenance free operations during these intervals.
For example, if the engine is operated in extremely dusty conditions, the air cleaner should be cleaned every day instead of every 50 hours.

15-1 DAILY CHECKS and MAINTENANCE

Checks and maintenance	Reasons for requiring them
Remove dust or grass from whatever parts which accumulated or clogged.	The governor linkage is especially susceptible to dust.
Check external fuel leakage. If any, retighten or replace.	Not only wasteful but also dangerous
Check screw tightening. If any loose one is found, re-tighten.	Loose screws and nuts will result in vibration accidents.
Check oil level in crankcase and add up as necessary.	If the engine is operated without sufficient oil, it will fail.

15-2 INITIAL 20 HOURS CHECK

Checks and maintenance	Reasons for requiring them
Change crankcase oil.	To remove run-in wear particles

15-3 EVERY 50 HOURS (10 DAYS) CHECKS and MAINTENANCE

Checks and maintenance	Reasons for requiring them
Change crankcase oil.	Contaminated oil accelerates wear.
Clean air cleaner.	Clogged air cleaner harms engine operation.
Check spark plug. If contaminated, wash in gasoline or polish with emery paper.	Output power is reduced and starting is made difficult.

15-4 EVERY 100 ~ 200 HOURS (MONTHLY) CHECKS and MAINTENANCE

Checks and maintenance	Reasons for requiring them
Clean fuel filter and fuel tank.	The engine will be out of order.
Clean contact breaker points.	The engine output drops.
Remove grass, chaff or dirt clogged the air cooling system. Remove the blower housing and clean it.	The engine overheats.

15-5 EVERY 500 ~ 600 HOURS (SEMIANNUAL) CHECKS and MAINTENANCE

Checks and maintenance	Reasons for requiring them
Remove cylinder head and remove carbon deposit.	The engine will be out of order.
Disassemble and clean carburetor.	

15-6 EVERY 1000 HOURS (YEARLY) CHECKS and MAINTENANCE

Checks and maintenance	Reasons for requiring them
Perform overhauls, clean, correct or replace parts.	The engine output drops and become out of order.
Change piston rings.	
Replace fuel pipe once a year.	To prevent from danger caused by the fuel leakage.

15-7 PREPARATION for LONG STORAGE

1) Perform the above 15-1 and 15-2 maintenance jobs.
2) Drain fuel from the fuel tank and carburetor float chamber.
3) To prevent rust in the cylinder bore, apply oil through the spark plug hole and turn the crankshaft several turns by hand. Reinstall the plug.
4) Turn the starting pulley by hand and leave it where the resistance is the heaviest.
5) Clean the engine outside with oiled cloth.
6) Put a vinyl or other cover over the engine and store the engine in dry place.

Industrial Engines

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